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Transactions of American Society for Steel Treating

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SPECIAL FEATURES

Indianapolis Convention Sets New Record in Attendance and Number of Papers Presented

Annual Address of the President

Report of the National Secretary

Many Companies Display Products and Equipment at Indianapolis Exhibition

What the Trade Journals Say

List of Authors and Pages on Which the Abstracts of Their Papers Appear

Abstracts of Papers Presented at Indianapolis Convention

A Contribution to the Problem of the Influence of Mass in Heat Treatment — *E. J. Janitzky*

Efficiency of Various Quenching Mediums with Their Practice and Applications — *James B. Morey*

Investigation of Fatigue of Metals Under Stress — *H. F. Moore*

Heat Treatment Not Always the Cause of Failure — *Charles A. Brooks*

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Why Do They Do It?

Somewhere, to-day, somebody is allowing five to ten thousandths of an inch *more* than is necessary for grinding and lapping after hardening some intricate die or gauge or other fine precision tool.

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TRANSACTIONS

of the

American Society for Steel Treating

Vol. II Cleveland, October, 1921 No. 1

A SUCCESSFUL CONCLUSION TO A SUCCESSFUL YEAR

WITH the Third Annual Convention and Exhibition of the American Society for Steel Treating passed, another achievement has been accomplished. In spite of the fact that the country is beclouded with an industrial depression which demands a policy of economy, both the Convention and Exhibition were distinct successes. It was a fitting finish for the first year of the new society. Just one year ago the Society was newly organized by the amalgamation of two smaller heat treating societies. It was then a great task to knit the two memberships into one working unit and to determine the policies which would guide the activity of the organization in the future.

These problems were soon solved. Reports of national officers proved this. Within one year's time the membership enjoyed a growth of 18 per cent or 487 members, raising the total from 2750 to 3237 on Sept. 1, 1921. Local chapters have increased from 27 to 31 and a new one is to be installed shortly at Rockford, Ill. Several more applications have been received. It is most unfortunate that the entire membership was not present at Indianapolis to hear the report of the National Treasurer. With all bills paid the treasury contained a substantial cash reserve, indicating that the Society is approaching a position for increased service as a result of its financial position. Possibly research in steel treating lines is not far distant.

Considerable interest was shown in the technical sessions of the Convention where many valuable papers were presented. Some 80 papers were presented, about half of this number being presented by title. It is to be regretted, however, that a lack of time prevented proper discussion being given each paper, for the great purpose of all technical conventions is to discuss pertinent problems of the trade. Lack of time for discussion had been anticipated and brief abstracts of the papers were distributed to assist in provoking discussion, but the abstracts proved to be so brief that they were of little use in this respect. It will prove advantageous in the future to either limit the number of papers presented, or to extend the time for their discussion. This matter must receive careful attention before the next Convention.

Retiring officers of the Society must be commended for their work during the past year for it has been by their efforts that the organization is able to take its place among the leading technical societies of the country. And it is with the best wishes and assurance of co-operation that the membership greets the new officers.

FRANK P. GILLIGAN

Elected National President of the American Society for Steel Treating

Officers of The American Society for Steel Treating

1921–22

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Metallurgist, Philadelphia Navy Yard, Hull Division, Philadelphia, Pa.

A. E. WHITE
Director, Department of Engineering Research, University of Michigan, Ann Arbor, Mich.

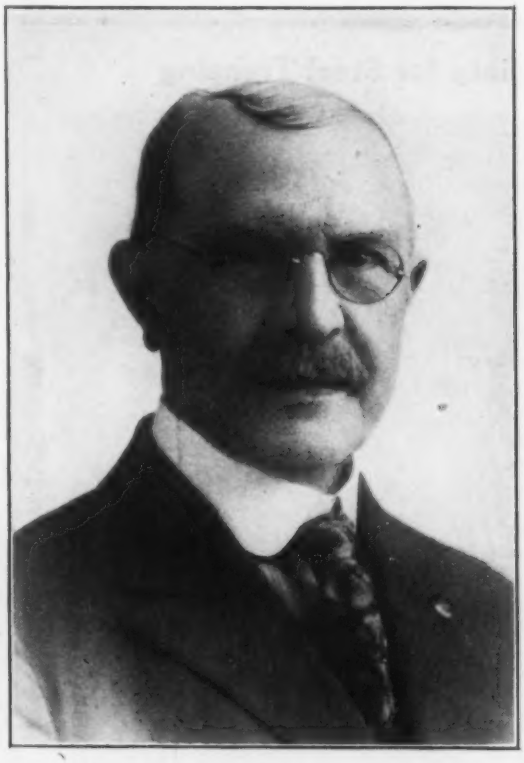
INDIANAPOLIS CONVENTION SETS NEW RECORD IN ATTENDANCE AND NUMBER OF PAPERS PRESENTED

WITH 1475 registered members and guests in attendance at the Third Annual Convention at Indianapolis, Sept. 19-24, a new high record was set for attendance. This showing seems remarkable in view of the fact that the Society has but 3237 members. Unusual interest was attached to the meetings which were well attended. In all some 80 papers were presented, about half by actual presentation and the remainder by title. Unfortunately, however, the number of papers presented was too great for the time allowed, thus what little discussion was permitted was not productive of much result. A necessary postponement of the Wednesday afternoon session also assisted this congestion.

Several new features were introduced in the program this year and included the use of simultaneous sessions and the introduction of research and management and costs into the subjects for consideration. Without doubt both of these will receive more attention in the future. Much credit must be given to the Indianapolis Chapter which arranged the entertainment program for their guests, for no detail had been overlooked. The entertainment features were a highlight of the Convention.

Opening Session on Monday

The Third Annual Convention of the American Society for Steel Treating was opened Monday afternoon, Sept. 19, in the Manufacturers' building, Indiana State Fair grounds, Indianapolis. W. R. Chaplin chairman of the executive committee of the Indianapolis Chapter welcomed the Society to the city on behalf of the local chapter. Claude Wallin, secretary to Mayor Jewett welcomed the Society to Indianapolis and his greeting was responded to by Lieut. Col. A. E. White, National President, who then assumed the chair.



F. C. LAU
Elected First Vice President of the Society

R. J. ALLEN
Elected Second Vice President of the Society

J. V. EMMONS
Elected National Treasurer of the Society

J. J. CROWE
Elected National Director of the Society

The regular order of business was conducted as scheduled. R. T. Bayless, chairman of the tellers of election reported that 606 ballots were cast for the new officers, however, 14 ballots were defective and were thrown out, leaving an actual count of 592 ballots for the new officers, whose names and photographs appear on other pages of this issue.

W. S. Bidle, National Treasurer, read his report which briefly rehearsed the financial affairs of the Society from the time of amalgamation of the two societies at Philadelphia last year to Sept. 1, 1921. At the latter date, every obligation had been met and a substantial cash balance was deposited in the treasury. The satisfactory showing was made possible by the greatest of co-operation between the national officers and directors in directing the affairs of the Society. W. H. Eisenman, National Secretary, in his annual report outlined the growth and activities of the Society during the past year. He announced that at the time of amalgamation the organization had 2750 members, which number has since increased to 3237, an increase of 487 or 18 per cent. Likewise local chapters have increased from 27 one year ago to 31 at the present time, chapters having been granted to Syracuse, Charleston, Gary and Worcester. He also announced the granting of a chapter to Rockford, Ill., the installation to take place in the near future. The Secretary's address appears in full on page 25 of this issue. The afternoon session was brought to a close with the annual address of the President in which Lt. Col. White summarized in detail the activities of the Society and made a number of recommendations for the guiding of affairs in the future. President White's address appears on page 16.

Program of Technical Sessions

With some slight changes in the program, the technical meetings were conducted as scheduled. Carburizing was the subject of the technical meeting held on Tuesday morning, J. Culver Hartzell, consulting metallurgist, Blue Ash, O., being chairman. The papers presented at this meeting were: "A Comparison of the Rate of Penetration of Carbon Into Various Commercial Steels in Use for Case Carbonizing," by S. C. Spaulding, metallurgist, Halcomb Steel Co., Syracuse, N. Y.; "Do Alloy Carbonizing Boxes Pay?" by C. M. Campbell, superintendent, Pioneer Alloy Products Co., Cleveland; "Carbonizing with Wood Charcoal," by H. Schagrin, chief chemist, United States naval ordnance plant, Charleston, W. Va.; and "The Design of Heat Treating Containers," by H. H. Harris, president, General Alloy Co., Chicago.

Simultaneous sessions were held on Tuesday afternoon, one session being devoted to tool steel with F. B. Foley presiding, and the other devoted to the heat treatment of special products with H. M. Boylston, professor of metallurgy, Case School of Applied Science, Cleveland, as chairman. Papers presented at the tool steel session were: "Physical Tests on High Speed Steel," by A. H. D'Arcambal, metallurgist, Pratt & Whitney Co., Hartford, Conn.; "Influence of the Heating Medium on Structural Changes in Steel," by A. E. Bellis, president Bellis Heat Treating Co., New Haven, Conn.; "Preparing Tool Steel at the Mill," by A. W. F. Green, metallurgist, John Illingworth Steel Co., Philadelphia; and "Tool Steel Manipulation," by L. K. Marshall, metallurgist, North East Electric Co., Rochester, N. Y.

At the special products session, consideration was given to the following papers: "Dow Metal and Its Application," by J. A. Gann, research department, Dow Chemical Co., Midland, Mich.; "Brass Forgings," by H. L.

Hess, H. L. Hess Co., Philadelphia; "Duralumin," by W. B. Stout, president Stout Engineering Laboratories, Detroit; and "Heat Treatment of Copper and Brass," by F. L. Helrigel, metallurgist, Motor Products Co., Detroit.

Because of the postponement of the 50-mile automobile race from Wednesday morning to Wednesday on account of rain, the technical program for the afternoon was postponed until Thursday when the papers were read at an extra session during the afternoon. Simultaneous meetings were held Thursday morning, one session with Dr. J. Culver Hartzell presiding being called the army and navy session and the other with C. N. Dawe, metallurgical engineer, Studebaker Corp., Detroit, as chairman, discussing alloy steel.

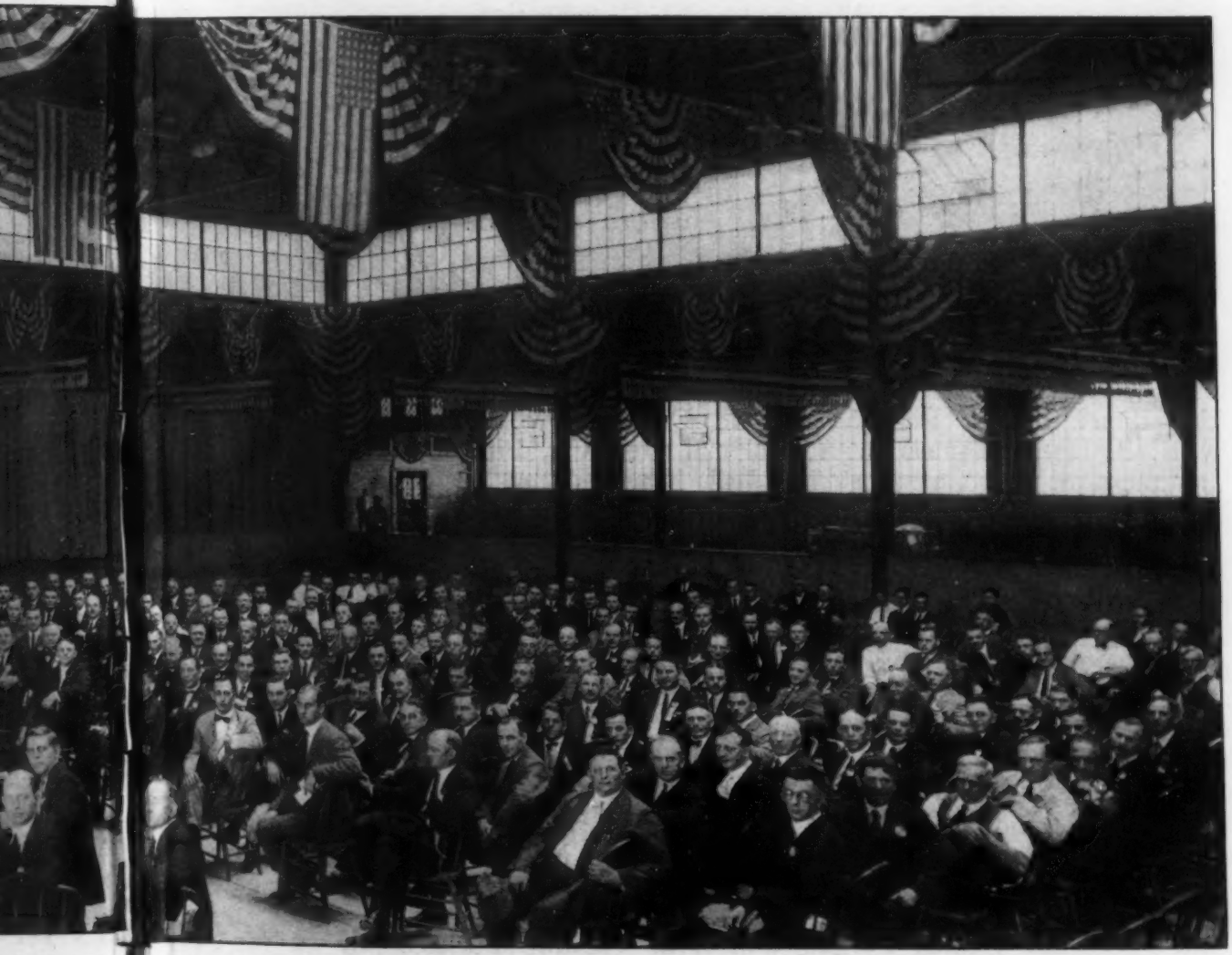
The program of the army and navy session was general in nature. Lieut. Charles Bradner, chief chemist, chemical warfare service, presented a paper on "Poisonous Gases," Commander George Leary, United States navy, presented two papers, "The North Sea Barrage" and "Railway Gun Mounts," both being illustrated. "Planning and Routing of Forging and Heat Treatment Work at Watertown Arsenal" was the subject discussed by F. C. Langenburg, metallurgist Watertown arsenal, Watertown, Mass.

Papers discussed before the alloy steel group were: "Effect of Heat

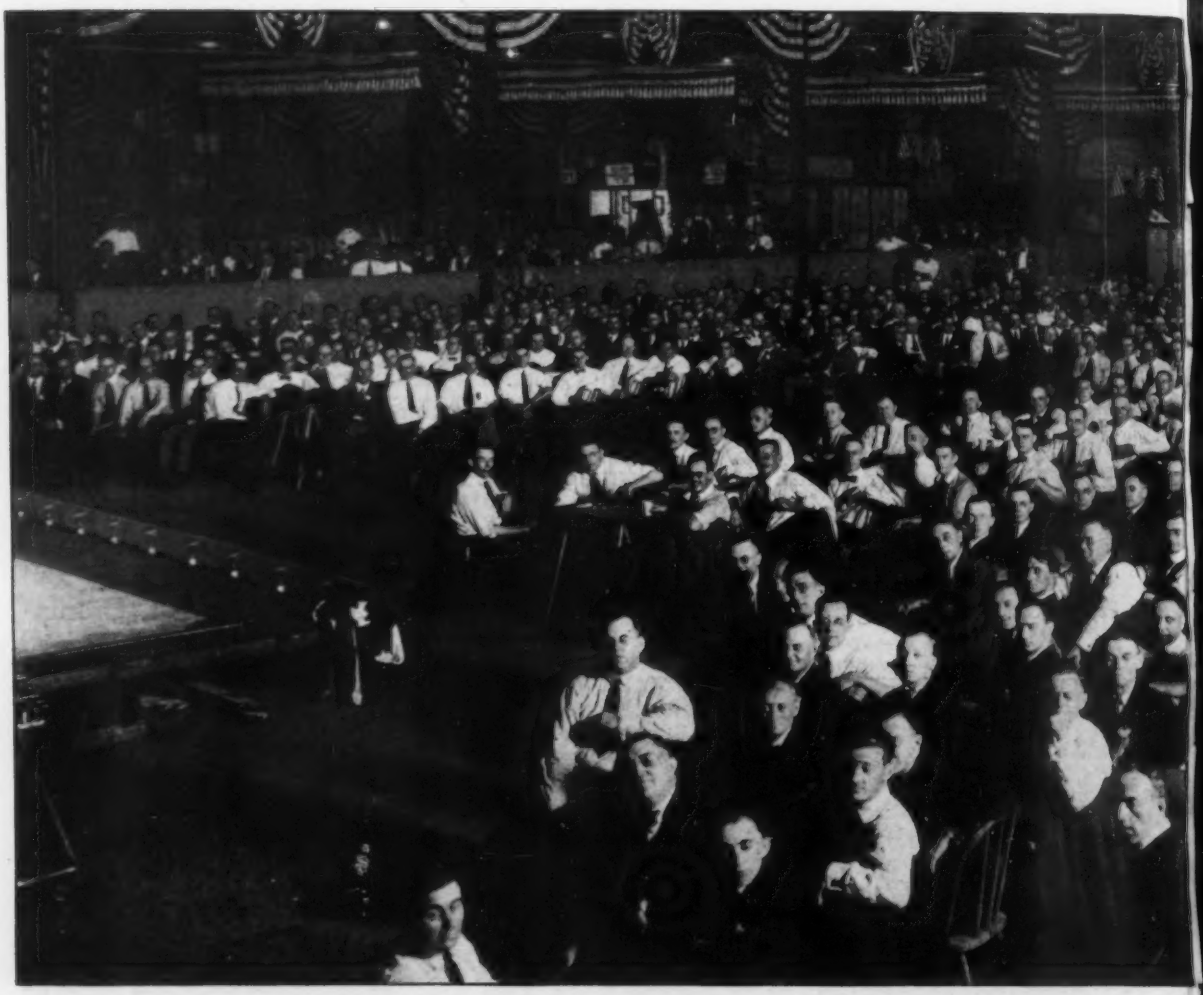
THE OPENING SESSION OF THE CONVENTION WHICH WAS HEL IN T

Treatment on the Mechanical Properties of a Carbon-Molybdenum and a Chrome-Molybdenum Steel" by H. J. French, physicist, bureau of standards, Washington; "A Comparison of American and English Methods of Producing High Grade Crucible Steels" by T. Holland Nelson, steel works manager, H. Disston & Sons, Philadelphia; "Mechanical Properties of Chrome Vanadium Steels" J. S. Vannick, metallurgist, fixed nitrogen research laboratory. Washington; and "Toughness of Alloy Steels as Affected by Their Heat Treatment" by M. H. Grossman, metallurgist, Electric Alloy Steel Co., Charleroi, Pa.

Three simultaneous sessions were conducted Thursday afternoon. The first on metallographic research with O. E. Harder, professor of metallurgy, school of mines, University of Minnesota, as chairman, considered the following papers: "Metallography of High Speed Steel" by J. P. Gill and L. D. Bowman, metallurgists, Vanadium Alloy Steel Co., Latrobe, Pa.; "Some Alloy Steels of High Elastic Limit; Their Microstructure and Heat Treatment" by C. M. Johnson, director of research, Crucible Steel Co. of America; "Efficiency of Different Mixtures for Cyanide Hardening and the Role of Nitrogen in the Process" by V. E. Hillman, metallurgist, Cromp-



WAS HEL IN THE MANUFACTURERS BUILDING ON MONDAY AFTERNOON

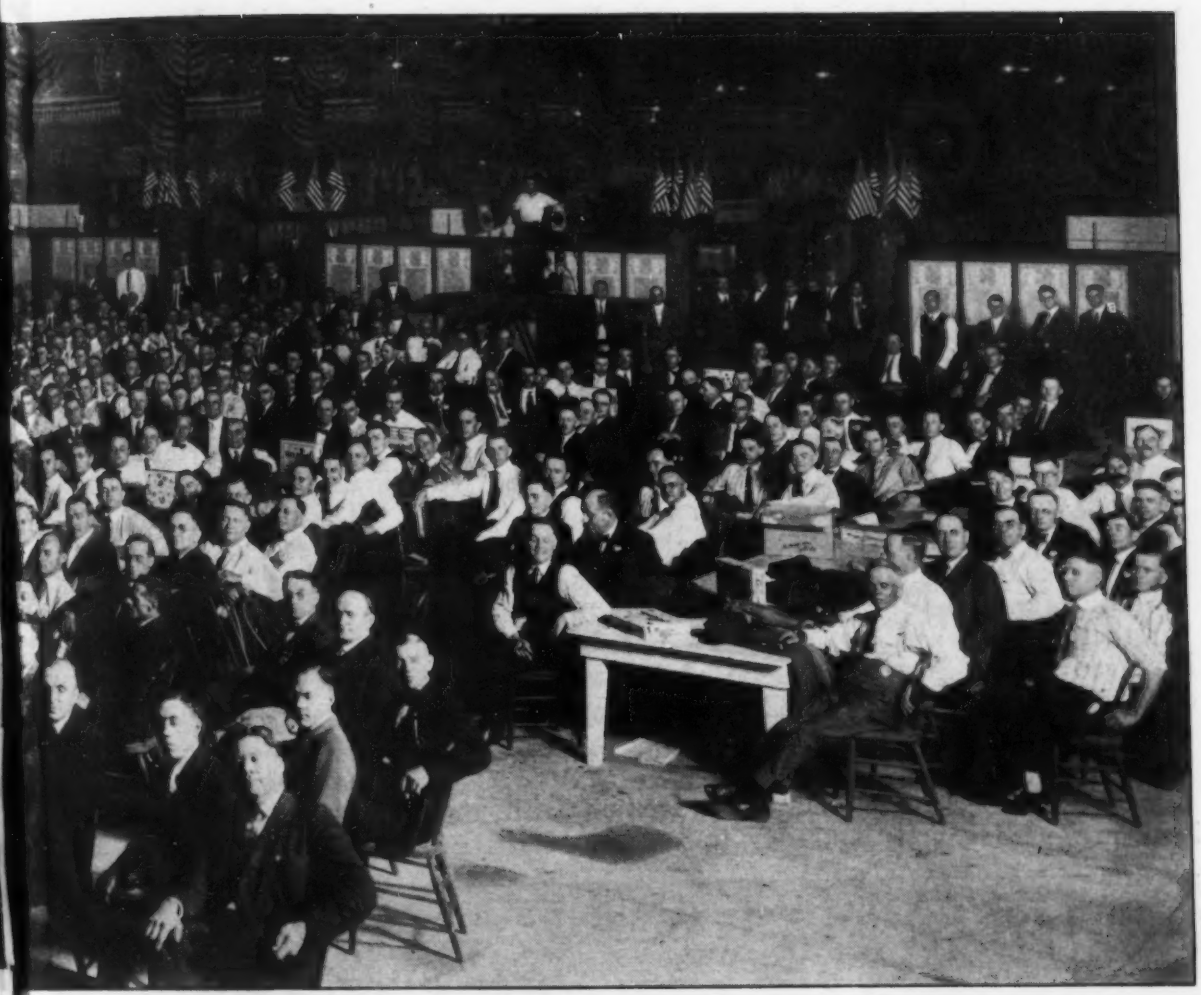


A PHOTOGRAPH OF THE SMOKER WHICH WAS HELD ON TUESDAY EVENING

ton & Knowles Loom Works, Worcester, Mass.; "Ghost Lines and Grain Elongations in Hot Rolled and Cold Drawn Low Carbon Steel Wire" by N. B. Hoffman, metallurgist, Colonial Steel Co., Pittsburgh; and "Heat Treatment of Chrome Steel for Ball Bearings" by H. Styri, chief of S. K. F. Research Laboratories, Philadelphia.

The second session with A. W. F. Green, metallurgist, John Illingworth Steel Co., Philadelphia, presiding, discussed heat treating equipment, the papers presented being as follows: "Automatic Compensation for Variations of Cold Ends of Thermoelectric Pyrometers" by W. H. Bristol, president, the Bristol Co., Waterbury, Conn.; "Skipping the A. B. C's to Talk the X. Y. Z's of Temperature Measuring Instruments" by George Keller, sales manager, Brown Instrument Co., Philadelphia; and "A New Type Regulator: Its Application to Heat Treating Problems" by R. W. Newcomb, manager, Charles Engelhard, Inc., New York.

The third session also on heat treating equipment and with T. D. Lynch, metallurgical engineer, Westinghouse Electric & Mfg. Co., Pittsburgh, as chairman discussed the papers: "Construction of Furnace Doors, Linings and Bases" by E. F. Davis, sales engineer, Celite Products Co., New York; "An Electrically Heated Forging and Heat Treating Furnace" by G. M. Little, Westinghouse Electric & Mfg. Co., Pittsburgh; "What Insulation



IT WAS A WARM EVENING AS EVIDENCED BY THE DISCARDING OF COATS

Will Do for the Heat Treater" by T. J. Gower, sales engineer, Armstrong Cork & Insulation Co., Pittsburgh; "Gas Accessories for the Heat Treating Room," J. Weaver Smith, industrial engineer, Citizens Gas Co., Indianapolis; and "Operating Data on Electric Furnaces" by R. E. Talley, chief engineer, George J. Hagan Co., Pittsburgh.

Two meetings were held on Friday morning, one of which was the research session with H. E. Howe, chairman, division of research extension, national research council, as chairman. Papers presented were: "Field Industrial Research" by E. F. Hyde, director of research, Nela research laboratory, Cleveland; "National Aspect of Research" by C. A. Adams, chairman, division of engineering, national research council; "What the University Owes the Industries" by Prof. A. E. White, director of engineering research, University of Michigan, Ann Arbor, Mich.; "The Role of Government Laboratories in Industrial Research" prepared by George K. Burgess, chief of division of metallurgy bureau of standards, Washington.

Management and costs were considered at the other morning session presided over by Dr. Culver Hartzell, the papers presented being: "Determination of Heat Treating Costs" by H. F. Wood, chief metallurgist, Ingalls-Shepard Division, Wyman-Gordon Co., Harvey, Ill.; "Buying Steel

on Closer Carbon Limits" by E. W. Pierce, chief metallurgist, Maxwell Motor Co., New Castle, Ind.; "A Successful Bonus System Applied to Heat Treating" by A. A. Blue, metallurgist, Duff Mfg. Co., Pittsburgh; and "The Electric Furnace as It Affects Overall Costs of Heat Treated Parts" by C. L. Ipsen, designing engineer, General Electric Co., Schenectady, N. Y.

Heat treating problems were considered at the Friday afternoon session with H. J. French, physicist, bureau of standards, as chairman. The papers discussed were: "Coarse Grained Forgings, Their Detection and Correction" by L. S. Cope, metallurgical engineer, Dannemore Steels, Inc., New York; "Tests Showing the Effect of High Temperatures on Malleable Iron" by T. D. Lynch and W. J. Merten, metallurgical engineer, Westinghouse Electric & Mfg. Co., Pittsburgh; "Fracture Tests on Steel to Determine Its Quality" by W. J. Priestly, superintendent hot metal division, United States naval ordnance plant, Charleston, W. Va.; "A Contribution to the Problems of the Influence of Mass on Heat Treatment" by E. J. Janitzky, metallurgist, Illinois Steel Co., South Chicago, Ill.; and "A Coiling and Heat Treating Plant for Helical Springs" by W. J. Merten, metallurgical engineer, Westinghouse Electric & Mfg. Co., Pittsburgh.

Many more papers were presented by title at the various sessions, but these papers are not mentioned here since a complete list of all papers appeared in the September issue of TRANSACTIONS. Abstracts of the various papers appear on page 32 of this issue.

Two Honorary Members Elected

Meetings of chapter delegates together with the national officers were held on Tuesday and Thursday noons immediately following lunch. While

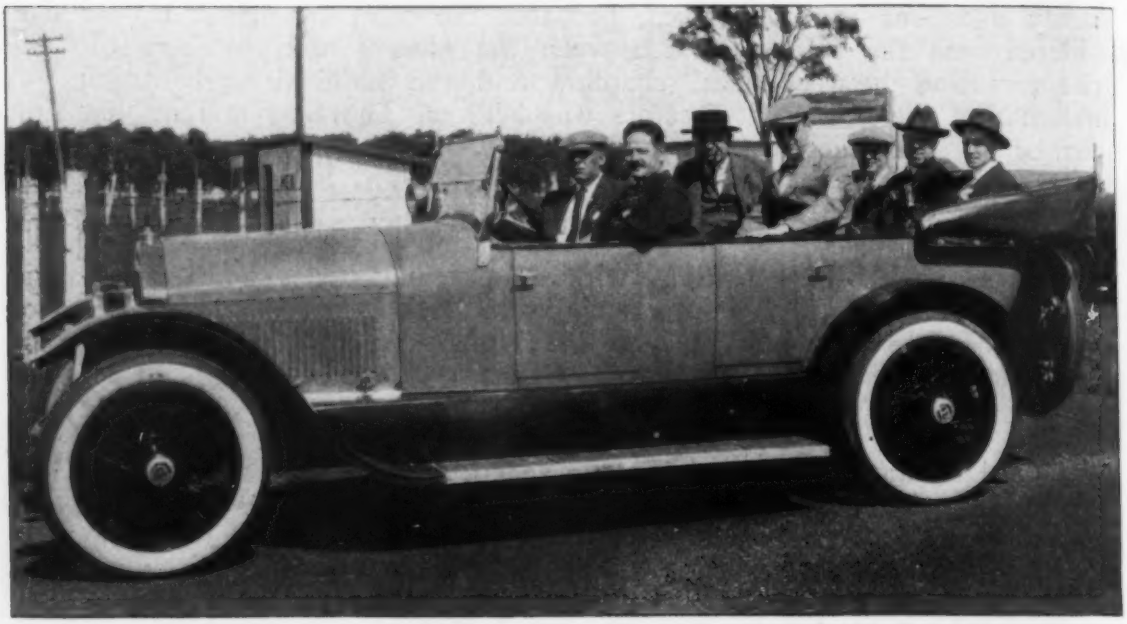
NEARLY 400 ATTENDED THE ANNUAL BANQUET ON THURSDAY EVENING AT TE LAYPOO

many questions were discussed, probably the most important matter considered was the co-operation between the officers and members of local chapters and between local chapters and the national organization. A meeting of the board of directors was held on Thursday and at that time elected to honorary membership in the Society Dr. John A. Mathews, president Crucible Steel Co. of America, Pittsburgh, and Elwood Haynes, president Haynes Motor Car Co., and Haynes Stellite Co., Kokomo, Ind. Both men are prominent in steel treating and metallurgical work, Doctor Mathews for his investigations with molybdenum steels and Mr. Haynes for his invention of a nonferrous cutting alloy. With the election of Doctor Mathews and Mr. Haynes, the number of honorary members of the society was increased from four to six.

Entertainment Provided Is a Feature

Special mention must be made of the entertainment program which was one of the features of the Convention. Due credit must be given the Indianapolis Chapter which through George Desautels, chairman of the entertainment committee, had provided a most complete and elaborate series of events for the entertainment of members and their guests. A smoker was held in the Manufacturers Building on Tuesday evening. Practically every available seat was taken and standing room was utilized, it being estimated that over 2000 attended. In spite of the fact that Mr. Desautels claimed the Indianapolis police station was well supplied with "Anti-Volstead Quenching Medium," a number of kegs of cider was the best the committee was able to provide, and the hardness number of that is a secret. Plenty of doughnuts were supplied as were cigars and cigarettes.

NG AT TH LAYPOOL HOTEL. THE SPEAKERS' TABLE IS SHOWN IN THE RIGHT CENTER



The pacemaker which started the 50-mile race. From left to right are: William Thompson, president Stutz Motor Car Co. of America, Indianapolis; W. H. Eisenman, national secretary of the society; Barney Oldfield, former race driver, Cleveland; Chester Ricker, director of timing, official of American Automobile association; Gil Anderson, sales manager, Duesenberg Automobile & Motors Co., Inc., Indianapolis, and former race driver; Lieut. Col. A. E. White, president of the society; and F. P. Gilligan, president-elect of the society

The function had been announced as a smoker and it was a smoker with the air thick and blue but the atmosphere was far from the same. With many songs and a first-class vaudeville and cabaret show going on continuously, it was a jolly good crowd. Colonel White received his share of the good time and permitted George Desautels to slip one over on him when he was presented with a brand new phonograph packing case. But when the Colonel took invoice of the contents he found it contained the next number on the program—a dancing maiden. The Colonel's acceptance was cut short by a hasty exit from the stage. A photograph of the smoker is shown on page 8 and had it been taken later in the evening instead of at the start could have been captioned "Ain't We Got Fun."

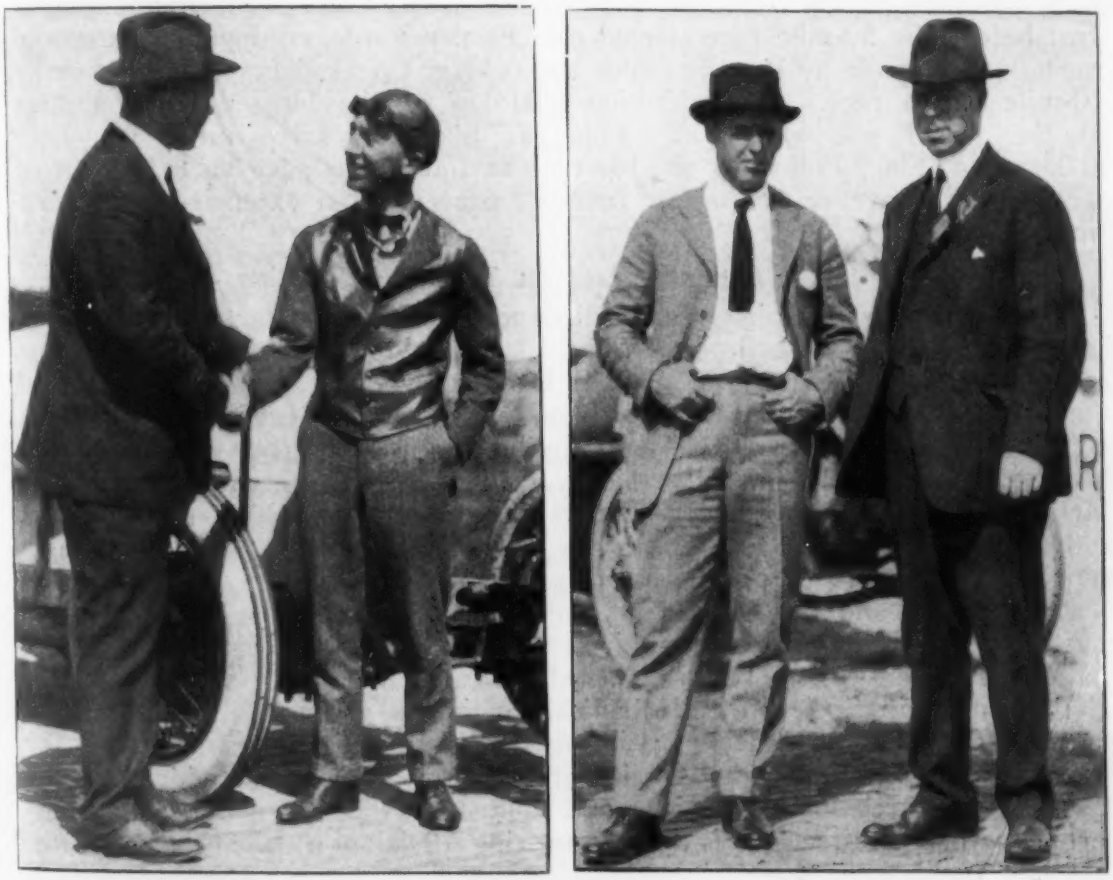
A 50-mile automobile race at the Indianapolis Motor Speedway on Wednesday morning perhaps was the biggest event on the program. The race was scheduled for 10 a. m. but a heavy rainfall in the early morning necessitated postponement until noon and also a reducing of the distance from 100 to 50 miles. Because of lack of time qualification tests were eliminated, the drivers drawing for position. The race, which was the first ever to be held on the Indianapolis course outside of the usual Memorial Day events, was sanctioned by the American Automobile Association, with the agreement that any records made would be official. Seven cars were entered, three Frontenac, three Duesenberg and one Peugeot. Details of the cars, drivers and speed are given as follows:

Order of Finish	Car	Driver	Time
First	Peugeot	Howard Wilcox	30:50.64
Second	Duesenberg	Jimmy Murphy	31:27.85
Third	Frontenac	Jules Ellingboe	32:23.18
Fourth	Duesenberg	Joe Thomas	32:25.48
Fifth	Duesenberg	Eddie Hearne	34:19.75
Sixth	Frontenac	Charles Van Ranst	36:27.22
	Frontenac	Bennie Hill	Car Wrecked

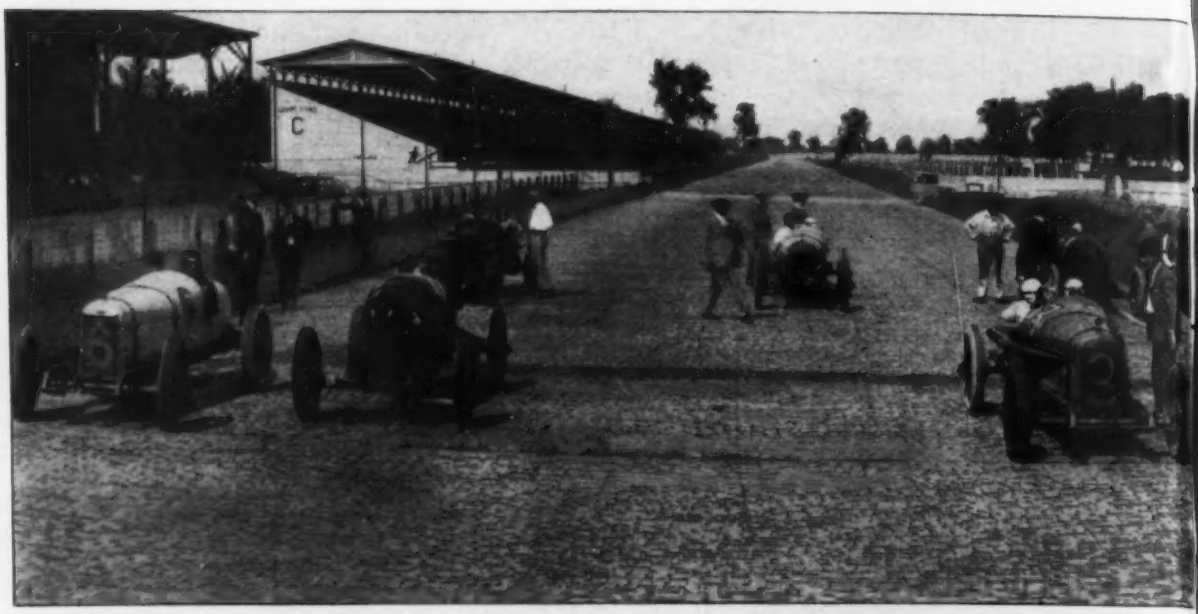
Howard Wilcox, driving a French Peugeot, won the race, averaging 97.5 miles per hour. Jimmy Murphy, recent winner of the Grand Prix, was second in a Duesenberg, losing the lead which he commanded from the very start until the last lap when engine trouble developed and he was forced to limp across the finish line. An unfortunate incident of the race was the wrecking of Bennie Hill's Frontenac car in the tenth lap and while holding third place. Both the driver and his mechanician, Henri Frank, miraculously escaped serious injury and death when their car jumped the retaining wall on the south turn and flew high into the air landing about 100 feet from the point at which it went over the wall. Hill received cuts about the head and face and a number of body bruises, and Frank was scratched and bruised. Both were taken to the hospital where their condition was reported as not serious.

Hill was rounding the south turn at a speed estimated at about 85 miles an hour when his car suddenly veered and disappeared from sight. An ambulance was rushed from the infield, but because the car had jumped the wall, it was not located for several minutes. The racer was a complete wreck. According to persons who witnessed the mishap, the car, after going over the wall, was hurled through the air, breaking a telephone pole and landing with the drivers pinned beneath it. The accident was described as being one of the most spectacular ever witnessed at the speedway.

The lineup of the various cars as they appeared before the race



(Left) Lieutenant-Colonel White congratulates Jimmy Murphy upon second place in the 50-mile automobile race. (Right) Tommy Milton, prominent automobile race driver, and Lieutenant-Colonel White



The seven racing cars lined up for the start of the 50-mile race at the Indianapolis Motor Speedway. From left to right are Puegeot driven by Howard Wilcox; Duesenberg No. 3 driven by Eddie Hearn; Duesenberg No. 16 driven by Joe Thomas Ranst. The pacemaking car is shown at the extreme right. The race was won by Howard Wilcox who averaged 9 Bennie Hill was wrecked when it went over the

started is shown above. Approximately 10,000 people were in the grandstands and represented the members of the Society and their invited guests. Just before the 50-mile race started two Fronty-Fords, equipped with special racing heads made by the Chevrolet Bros. Mfg. Co., Indianapolis, provided a 10-mile match race. An exhibition trial lap of the Duesenberg champion of the world was also run. This car averaged 156.4 miles per hour at Daytona, Fla. Following the big race two airplanes gave an exhibition of stunt flying, however, strong air currents prevented an extensive demonstration.

Annual Banquet Held on Thursday Evening

On Wednesday evening the Indianapolis Chapter entertained with an informal dance in the ballroom of the Claypool Hotel. Many members and guests attended. The Third Annual Banquet of the Society was held in the Riley Room of the Claypool Hotel on Thursday evening with about 400 members, ladies and guests attending. Following the serving of the banquet, Lieut. Col. White presided, calling upon Governor Warren T. McCray of Indiana and Mayor Charles W. Jewett of Indianapolis for short addresses. At the request of Secretary W. H. Eisenman, a standing vote of appreciation was tendered the retiring president following which Dr. Albert Sauveur, honorary member of the Society assumed the chair as toastmaster. The first address was given by A. A. Potter, dean of engineering, Purdue University, Lafayette, Ind. Dean Potter was a representative of the American Society of Mechanical Engineers and spoke briefly of the progress made by that society, pointing out how the American Society for Steel Treating could accomplish similar results. The second address, "The Spirit of Research in Engineering and Industry" was given by Prof. Comfort A. Adams, director of the engineering division of the National Research Council.

The principal address of the evening was, "Our Air Policies and the

left to right are shown Duesenberg No. 6 driven by Jimmy Murphy; Frontenac No. 9 driven by Bennie Hill; by Joe Thomas; Frontenac No. 1 driven by Jules Ellingboe; and Frontenac No. 2 driven by Charles Van who averaged 97.5 miles per hour. Jimmy Murphy was second and Jules Ellingboe third. The car of went over the wall in the tenth lap

National Defense," by Howard E. Coffin, vice president of the Hudson Motor Car Co., and member of the Naval Advisory Board. Mr. Coffin give a very eloquent talk and received a close following from his audience. He stressed the importance that airplanes would play in future armament policies of the world, and illustrated his convictions by many lantern slides and two reels of moving pictures of the recent airplane bombing tests conducted at Sandy Hook. The speaker also pointed out industrial unpreparedness handicapped the United States in its entry into the war. As a remedy for this in the future Mr. Coffin advocated the placing during peacetime of provisional contracts by the government. In event of war telegraphic notice would be sufficient to start production.

Presented Tokens of Appreciation

A number of excellent and unusual vaudeville features were dovetailed into the banquet program, which lasted until after 1 a. m. Near the close of the banquet Mr. Desautels as chairman of the Entertainment Committee was presented with a handsome gold watch and chain and Mrs. Desautels as chairman of the Ladies Entertainment Committee was presented with a beautiful diamond broach, the gifts signifying the appreciation for the splendid entertainment provided during the week.

The entertainment for the ladies as arranged by Mrs. Desautels included a visit to the exhibition on Monday evening, a theater party on Tuesday evening, a style show at one of the big department stores, several luncheons and automobile rides to various points of interest in Indianapolis.

Throughout the week members of the Society had the opportunity of visiting industrial plants in the city. The inspection trips were headed by various members of the Indianapolis Chapter. A list of the plants open for visitation was given in the September issue of TRANSACTIONS.

ANNUAL ADDRESS OF THE PRESIDENT

By A. E. White

Lieut.-Col. A. E. White

TO THE Directors, Delegates and Members of the American Society for Steel Treating:

I take pleasure in presenting for your consideration a statement of the work of the American Society for Steel Treating during the fiscal year 1920-21. I further take the liberty of incorporating in this report various recommendations and suggestions relative to the conductance of the work of the Society during the coming years, to which it is trusted that your national and local officers will give due consideration.

With much gratification do I acknowledge the splendid support which I have received as your President from your national officers, the support which they have received from the local chapter officers, and the support which they, in turn, have received from the membership at large. We must realize that no matter how conscientious and efficient officers you may have, they can accomplish little unless they have the whole-hearted and enthusiastic support of the membership as a whole. Such support has been the case this past year and I feel confident in predicting that the same will be true throughout the succeeding years.

I hesitate to commend anyone of your officers more than another for all have taken their work in the fullness of the trust that has been placed upon them and have given of their time, energy and thought unstintingly. Yet, I must speak of the excellent work which has been done by our National Secretary and by our National Treasurer.

Our Secretary, W. H. Eisenman, has been at his desk both days and nights, has thought of the Society at all hours, has been ever tactful, ever full of visions for its further development and progress and has been of great moment in bringing the Society to its present high standard of efficiency and service. Our National Treasurer has been a bulwark of strength in the activities of our Society. He has given the equivalent of days and weeks of his time without compensation. He was of great service in assisting our National Secretary at the time of the establishment of the offices in Cleveland and he placed his own offices at the service of our Society until such time as it was possible for us to move into our national headquarters. The sane, constructive financial policies which our Treasurer has enunciated these last 12 months will live for years to come and I believe we can with all due honor point to W. S. Bidle as the Alexander Hamilton of our Society.

Membership

The year 1920-21 has been a most successful one for this Society. The combined membership at the time of the amalgamation of the American Steel Treaters' Society and the Steel Treating Research Society was

approximately 2750. On Sept. 1, 1921, the membership of the American Society for Steel Treating was 3237. This represents a growth of 487 members during the past 12 months' period or an increase of substantially 18 per cent. Appreciating the unusual conditions which have existed during this period, growth of this magnitude is both surprising and gratifying.

Our chapters, also, have increased in number from 27 to 31; the new chapters taken in being our Syracuse, Charleston, Worcester and Gary chapters. The directors also have acted favorably upon the request from Rockford, Ill., for the establishment of a chapter and three other industrial centers have broached requests for chapters.

Finances

Our financial status is sound with a sufficient balance on hand today to carry us over any untoward periods, should such develop. I will not name any figures in this report as these will be given by our National Treasurer but as I have examined his monthly statements the substantial increases in free balance are an indication of the strong support which the Society is receiving from its members and the efficient method of handling and operating the Society.

Honorary Members

There have been elected to Honorary Membership this past year two metallurgists of national prominence and note. One is Prof. Albert Sauveur of Harvard University and the other is Prof. E. D. Campbell of the University of Michigan. Both men have rendered our civilization a distinct service in their findings and researches in the constitution and properties of iron and steel. In addition to these two men we have as honorary members Dr. Henry Marion Howe and Sir Robert Hadfield.

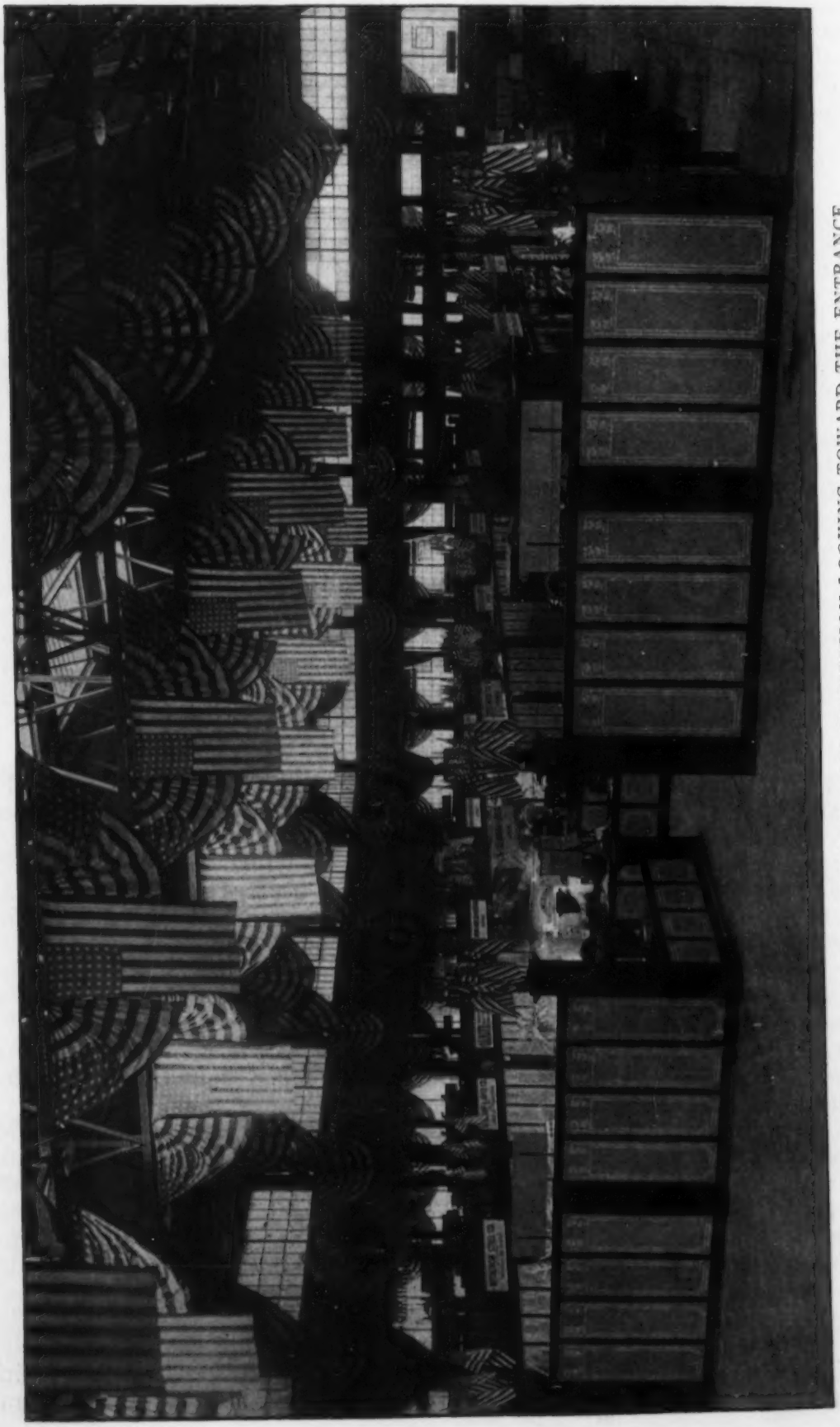
National Committees

The By-Laws of the Society call for nine national committees. By the authority of the Constitution and By-Laws vested in the President, I have appointed a further national committee which I have designated as the Program Committee, the membership of which consists of Harold Brown, Tri-City Chapter, Chairman, Dr. J. Culver Hartzell, Cincinnati Chapter and Don H. Stacks, Hartford Chapter. All of these 10 committees have organized and are beginning to give much consideration to their respective problems. In national societies the development of committee work is naturally a slow process but we may all feel gratified at the progress that has been made.

Our Finance Committee has been engaged in the control and supervision of our financial policies. These have been sound as evidenced by the excellence of the report which our Treasurer will make.

Our Publication Committee under the able direction of Prof. H. M. Boylston has given much thought and time to the general nature and character of our TRANSACTIONS. I have yet to hear from a single individual that our TRANSACTIONS as they stand before you today are not decidedly superior to what they were a year ago; both in the careful editing of the various manuscripts printed and in the general makeup and style of the magazine. Due credit in this connection should be accorded to our editor, E. F. Ross.

Our Meetings and Papers Committee has assumed the responsibility for the preparation of the program for the Convention. It was with regret that the resignation of Howard J. Stagg, Chairman of this Com-



A GENERAL VIEW OF THE INDIANAPOLIS EXHIBITION LOOKING TOWARD THE ENTRANCE

mittee was accepted. Prof. H. L. Campbell was appointed as his successor and the technical papers which will be given at this Convention were procured under his direction. George O. Desautels as a further member of this Committee has assumed all responsibility for the entertainment during the Convention.

Our Library Committee has been giving much thought to making possible the procurement of technical data desired by our membership. Dr. J. Culver Hartzell, Chairman of this Committee, has been particularly enthusiastic in this matter and has presented a report outlining a procedure which it is believed is so practicable that with the Directors' concurrence it will be put into effect this coming year.

Our Standards Committee has been attempting to ascertain how it can best operate without infringing upon or duplicating the work now so ably performed by our American Society for Testing Materials, our American Society of Mechanical Engineers, and our Society for Automotive Engineers. The annual report of the Chairman of this Committee, T. D. Lynch, gives indication that they are finding themselves and that they will be able to render the Society a distinct service without duplicating work now already done by other societies.

Our Research Committee have also been attempting to find themselves and to prepare recommendations relative to future activities. The situation is not one, essentially, of finding work but rather one of finding funds with which to do work. It is a dream of your President, though he has not as yet broached this matter to the Directors, that the time will come when our Convention and Exhibition will net the Society a sufficient sum so that our Research Committee may have funds available with which to work. Though our Society is today on a strong financial footing it is not yet in a position to support work of this type however much it may desire to do so; though it is trusted that in the not far distant future funds may be available from within the Society proper or through the donations of private individuals.

Our Constitution and By-Laws Committee with Capt. C. D. McQuigg as Chairman have given very serious consideration to the question of whether or not certain of the articles in our Constitution and By-Laws are for the best interests of the Society. It is their opinion that admission to the membership class should be broadened somewhat. They have also recommended certain other minor changes. All of these have been favorably acted upon by the Directors and within the next few weeks will be transmitted to the voting membership for confirmation.

The Nominating Committee met in session in the Spring of 1921 and prepared the slate which you elected to office this summer.

Our Membership Committee was extremely active during the fall, winter and spring of 1920-21. Much credit for our increase in membership must be laid to the activities of this Committee which was so ably directed by our First Vice President, T. E. Barker and upon his moving from Chicago to Denver by J. Fletcher Harper.

Our Program Committee which has only been appointed within the past few months places itself at the service of the various chapters for the purpose of recommending to them, when desired, possible speakers and subjects for chapter meetings. It is not the thought or intention of this Committee to make such recommendations unless the same are requested because we desire our chapters in all cases to feel free to con-

duct their activities and work in such manner as they see fit, provided only that they comply with the Constitution and By-Laws of the Society to which they have already subscribed.

Transactions

Casually our TRANSACTIONS has been mentioned in the work of the Publication Committee. We are all to be congratulated, I feel, in belonging to an organization which has such an excellent magazine. The articles presented are well written, well edited and set forth the most recent and up-to-date developments which are daily taking place in the field of heat treatment. We are most pleased in the excellent improvement in the character of our magazine during the past year. I do not know that there are any who could bring about the improvement as rapidly or more consistently than has been done by our editor and by our Publication Committee.

Yet, it is the prerogative of the President at this one time to incorporate in his report such suggestions as he believes may be for the good of the Society. In this connection I would be-speak an arrangement of this magazine so that it may cover more adequately, even more than it does today, the field of heat treatment. It is my personal feeling that in its pages we should cater to the technical man and to the shop man. Our articles, though not necessarily in the same contribution, should be of interest to both classes and they should be so arranged that there will be no misunderstanding relative to the purposes for which the articles are prepared. The technical man should be able to find without difficulty the articles he desires to read, and the shop man should be able to find without difficulty the articles which he is particularly interested in looking over. In this same connection we should give greater attention to our abstracts and trade notes.

The former would be of particular interest to the technical man and the latter to the shop man.

Thus I believe that our reading matter should very definitely be divided into four groups: (1) technical, (2) shop notes, (3) abstracts, (4) trade notes. To the first we have already given much consideration and doubtless most of the articles presented would be assigned to this group. The second is at present a fallow field. It is one which, if cultivated, will grow and develop and become of much interest and service to our shop man. The third field, abstracts, is one which has already been suggested by a number of those interested in the Society. It will go far, it is believed, in rendering that service to the membership of the Society which has been so admirably recommended by the Chairman of our Library Committee, Dr. J. Culver Hartzell. It will mean that not only will our membership have available the many technical articles which now appear in our own TRANSACTIONS; but also it will render possible a comprehensive survey of all activities in the field of heat treatment as now recorded in the technical press of the day. An excellent start has been made in the trade notes under "Commercial Items of Interest". These brief statements are personally of much interest to me and I feel that they must be of equal interest to the membership as a whole.

Two further fields which the publication covers are the "News of the Chapters" and the "Employment Service Bureau". The information contained in the "News of the Chapters" gives one a perspective with regard to the activities of neighboring chapters and cannot fail to stir our

local chapter executive committees with desires for emulation. It further renders valuable aid and assistance to our executive committees by giving them indirect suggestions relative to the proper method of handling and arranging their local chapter programs and activities.

Chapter Meetings

Your National Officers fully appreciate that the strength of the Society is fundamentally and unequivocably tied up with the strength of the respective chapters. They have not attempted to dictate in any manner relative to the chapter programs, feeling that each chapter knew its own local conditions best, although they have been much concerned with regard to them and with regard to the general procedure leading up to their development. With 31 chapters in as many different centers, there are of necessity those manifesting great strength and those giving evidence of some weakness. It has been my privilege to visit 26 of the 31 chapters and because of this privilege I take this opportunity of presenting for your consideration certain observations which have been forcefully brought to my attention.

Selection of Executive Committee

I believe it is of paramount importance that great care and thought be employed in the selection of your Executive Committees. Pick out for this work men who have the reputation for taking their responsibilities seriously and who can be depended upon to follow through any program until they see the same successfully completed. If you appoint for your Executive Committee men of that caliber and type I believe you need have no fear for the success of your chapter during the year in which they are in office. I can give instances of promises made and broken and I can give instances in greater number, I assure you, of promises made and kept. Those who have made promises and failed made them in my judgment with the best of intentions and with every desire to carry them to a successful fruition. Yet, their failure has been due in quite a large measure to a lack of a proper follow up system, because human nature is so ordered that most of us need to be repeatedly reminded of the things we have agreed to do in order that we may carry them through.

Alliance With Other Engineering Societies

There is an old saying "In union there is strength". This seems to be the case with our technical societies for I have noted that where our chapters are in close alliance with other technical societies in their own communities there is always a successful chapter. Further, I have noted that our weaker chapters are, for the most part, those which exist in communities where there is no bond of union between the technical societies. In view of this condition, therefore, I strongly recommend to the various chapters in this Society that they make every possible effort to co-operate with the various technical societies in their community and unite with them by alliance when such is possible, for in no case have I yet found that such alliance involves lack of identification with the national societies to which each group belongs. I believe our Directors look with favor upon uniting with the Federated American Engineering Societies but have not joined this federation at present because of the cost entailed, which as we now stand would involve an expenditure of something like $4800. This matter is brought up at this

BOOTHS WERE ATTRACTIVELY AND NEATLY ARRANGED AS SHOWN IN THIS ILLUSTRATION

time to indicate that the failure of your National Society to join the Federated American Engineering Societies is due to financial considerations rather than to lack of sympathy with the movement.

Character of Meetings

I submit for your consideration three suggestions relative to the character and nature of your meetings. These matters are being given due consideration by the Program Committee but the suggestions contained are ones which I have culled from my book of experience during this past year.

(a) *Nature of Program*—Fundamentally I believe that our local program committees should make every possible effort to provide at each session a proper combination of the technical and that which, for lack of a better term, I will call the entertaining. There is an old saying that "All work and no play makes Jack a dull boy and all play and no work makes Jack a big shirk". I believe our technical societies as a whole have operated without due appreciation of the significance of the truth of this proverb. I believe the reason why it has been so difficult to procure proper attendance at many of the sessions of our technical societies has been due to the lack of anything of an entertaining character on our programs. In the entertaining we do not need to go to the vulgar either as set forth in so many of our moving pictures today or in the activities of many of our cabaret entertainers. Yet, we do need that which will bring a smile and a laugh as well as we need that which will lead toward the development of our technical knowledge. Our churches for long years have seen this need, for in addition to the sermon we have congregational singing and selections from well-trained choirs or quartettes with well-modulated voices. Personally I cannot understand why our technical societies have been so backward in appreciating this proper demand for the technical and the entertaining. I hope that during this year our chapters will take care of this feature to a greater extent even than they have done in the past through the incorporation into their program, in addition to the technical, of such drawing cards as refreshments, smokers, moving pictures, speakers known for their ability to produce a laugh and such cabaret features as are worth while.

(b) *Date and Place for Meeting.* It has been my observation that those chapters which meet at a given time each month and which have a definite meeting place are always assured of good attendance. I know the claim is made that speakers of note cannot be procured on any given date. Personally I feel such claims are made only by those who, in the preparation of their program, have delayed in its arrangement to the last minute and have been compelled, therefore, to adopt their date to the engagements of the speaker rather than for the speaker to adopt his program to the arrangements of the Chapter. Personally I feel that every chapter should have a most definite date for meeting and that a strong effort should be made to have the meeting place always in the same building. The practice of sending out notices to the members two or three days preceding the date of the meeting results in poor attendance and in much absence.

(c) *Program.* It is recommended that each local chapter arrange during the summer the program for the fall, winter and spring meetings. This committee should very properly arrange its program with no

thought of the speakers and on the arrangement of the program then they should make every effort to get the speaker desired for the program projected. Whether the talent be from within the chapter or outside is a matter for each local chapter to settle. There is a difference of opinion on this matter and I have observed that chapter interest is procured in both ways.

Conclusion

I wish to express my personal appreciation for the co-operation and assistance rendered me by every member, by every local officer, by our national standing committees and by the eight other members of your Board of Directors, whom I have learned to love and admire through the contact which it has been my privilege to have with them. I bespeak the same co-operation for your new officers who are about to assume the reins of responsibility and trust. Though in but a few days I will step down as President of your Society you can can rest assured that it will always have my heartfelt interest and that you can depend upon me for any possible service which lies within my power to render.

REPORT OF THE NATIONAL SECRETARY

By W. H. Eisenman

THE National Headquarters of the American Society for Steel Treating were established in Cleveland on Dec. 1, 1920. Work with the Philadelphia Convention and the necessary details involved in preparation for the change together with the fact that the offices rented were not available until the 15th of January delayed the process of moving until the date mentioned. The change necessitated the establishing of an entirely new office force and many changes in the method of keeping records were instituted. At the time of the amalgamation, the Society had 27 local chapters; since that time four new chapters have been organized, those of Syracuse, N. Y., Charleston, W. Va., Gary, Ind., and Worcester, Mass., while a charter has been granted by the Board of Directors for the establishing of a chapter in the city of Rockford, Ill. Practically all chapters have reported excellent attendance at their monthly meetings during the past winter, and all of them have made extensive plans and preparations for the coming year. The average attendance all of the chapters have had at their meetings has been approximately 100 members and guests, which means that there are 3000 individuals attending meetings of the Society each month, with a total attendance of over 30,000 for the year.

One of the most pleasing evidences of the worthiness of your Society is the fact that during the past year of industrial depression, the Society has shown a growth of 18 per cent in membership. On Sept. 15, 1920, the membership was 2750; on Sept. 1, 1921, the membership numbered 3237, an increase of 487.

The free employment service has functioned this year with considerable success, and as business conditions open up, should be able to be of much greater service to its members and the manufacturing industries.

Your National Secretary during the past year has traveled over 35,000 miles in looking after the interests of the Society. He has visited practically all of the chapters, and has been present at their regular meetings.

One of the most important developments the Society has made during the past year has been the increased value of its publication, TRANSACTIONS. The general makeup and appearance have been improved decidedly under the efficient editorship of E. F. Ross, while the number of pages has been increased. Over 780 pages of reading matter, exclusive of advertising, have been published in the 12 numbers since last September.

Special commendation should be given to the Publication Committee consisting of Messrs. Boylston, Emmons, and Thum for the painstaking efforts and large amount of time they have given in reading the papers submitted for publication. Special credit should be given to the firms using the pages of TRANSACTIONS as an advertising medium. Through all the vicissitudes of business, they have remained loyal and continuous for all of which the members of the Society are truly grateful and appreciative. The prospects for the future are especially bright and encouraging.

During the past year, the Society has not only increased its field of usefulness by extending its service to new members, but has also in-

creased its financial condition. The Society has not yet made an impression upon the field of possible members or of its potential usefulness, but the plans for the future now being formulated slowly with great thought and care, led on in the future as in the past by a spirit of usefulness and service, will continue to direct the Society to even more successful achievements.

MANY COMPANIES DISPLAY PRODUCTS AND EQUIPMENT AT INDIANAPOLIS EXHIBITION

ABOUT seventy manufacturers of steel treating equipment and heat treated products were represented with booths and displays at the exhibition held in the Manufacturers building. The hall was attractively decorated and the booths were well arranged, showing up effectively. Many of the exhibits, particularly those of furnaces, machinery and recording devices, were shown in actual operation, gas, compressed air and electricity being provided. Exhibition views are shown on accompanying pages.

During the six days the convention was open, approximately 10,000 people attended. In addition to being open throughout the day, the exhibition was open on Monday and Friday evenings. Saturday was known as Indiana Day, when the displays were thrown open to the public.

Following is the complete list of exhibitors represented by booths at Indianapolis. A list of equipment which they showed was given in September issue of TRANSACTIONS.

Alcorn, Blockhouse Co., Philadelphia, Pa.
Armstrong Cork & Insulation Co., Pittsburgh, Pa.
E. C. Atkins Mfg. Co., Indianapolis, Ind.
Bausch & Lomb Optical Co., Rochester, N. Y.
Bell & Gossett Co., Chicago, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Bureau of Standards, Washington, D. C.
Calorizing Co. of America, Pittsburgh, Pa.
Case Hardening Service Co., Cleveland, O.
Celite Products Co., New York.
Central Steel Co., Massillon, O.

LOOKING DOWN ONE OF THE AISLES IN THE EXHIBITION HALL

ANOTHER TYPICAL VIEW TAKEN IN THE MANUFACTURERS BUILDING

Chevrolet Bros. Mfg. Co., Indianapolis, Ind.
Cole Motor Car Co., Indianapolis, Ind.
Colonial Steel Co., Pittsburgh, Pa.
Crucible Steel Co. of America, Pittsburgh, Pa.
Deeds Commercial Laboratories, Indianapolis, Ind.
Deeds & Chapin Co., Indianapolis, Ind.
Domhoff & Joyce, Cincinnati, O.
Driver-Harris Co., Harrison, N. J.
Electric Alloy Steel Co., Youngstown, O.
Forging & Heat Treating, Pittsburg, Pa.
Electrical Refractories Co., East Palestine, O.
Charles Englehard, Inc., New York.
J. B. Ford Co., Wyandotte, Mich.
William Ganschow Co., Chicago, Ill.
General Alloys Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
George J. Hagan Co., Pittsburgh, Pa.
Haynes Motor Vehicle Car Co., Kokomo, Ind.
Halcomb Steel Co., Syracuse, N. Y.
Heppenstall Forge & Knife Co., Pittsburgh, Pa.
Hoskins Mfg. Co., Detroit, Mich.
Imperial Drop Forging Co., Indianapolis, Ind.
Indianapolis Drop Forging Co., Indianapolis, Ind.
The Iron Age, New York.
The Iron Trade Review, Cleveland, O.
Kinney Mfg. Co., Chicago, Ill.
Lafayette Motor Car Co., Indianapolis, Ind.
Leeds Northrup Co., Philadelphia, Pa. ,
Lexington Motor Car Co., Connersville, Ind.
Machinery, New York.
Marschke Mfg. Co., Indianapolis, Ind.
Maxon Furnace & Engineering Co., Muncie, Ind.
Midvale Steel & Ordnance Co., Cambria Steel Co., Pittsburgh, Pa.
National Motor Vehicles Corp., Indianapolis, Ind.
National Refining Co., Indianapolis, Ind.
Oakley Chemical Co., New York.
Quigley Furnace Specialties Co., Inc., New York.
W. S. Rockwell Co., New York.
P. H. & F. M. Roots Co., Connersville, Ind.
Shore Instrument & Mfg. Co., New York.
Simonds Mfg. Co., Lockport, N. Y.
Smith Gas Engineering Co., Dayton, O.
Spencer Turbine Co., Hartford, Conn.
Stevenson Gear Co., Indianapolis, Ind.
Stromberg Electric Co., Chicago, Ill.
Stutz Motor Car Co., Indianapolis, Ind.
Surface Combustion Co., New York.
Tate-Jones & Co., Inc., Pittsburgh, Pa.
Taylor Instrument Co's., Rochester, N. Y.
Vanadium-Alloys Steel Co., Latrobe, Pa.
Vonnegut Hardware Co., Indianapolis, Ind.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.
Wilson-Maeulen Co., New York.
Witherow Steel Co., Pittsburgh, Pa.

ANOTHER TYPICAL VIEW TAKEN IN THE MANUFACTURING

WHAT THE TRADE JOURNALS SAY

BOTH *The Iron Trade Review* and the *Iron Age* in the Sept. 29 issues of their publications, carried editorials regarding the recent convention of the Society. They should be of interest to readers of TRANSACTIONS and need no comment. *The Iron Trade Review* editorial reads as follows:

Steel Treaters Make Progress

"Accomplishments of the American Society for Steel Treating, which held its annual convention in Indianapolis last week, may be accorded notable recognition in the progress of American engineering societies. Although but one year old and formed by the amalgamation of two smaller societies devoted to the same purpose, the new organization has enjoyed a steady and well-rounded growth. When the United States entered the war, and the requirement of vast quantities of ordnance and special material became imperative, the knowledge of the science of heat treatment was comparatively limited. Considerable information began to be accumulated as production got under way and it was indicated that an important technical field had been neglected. Thus was felt the need for one great society to guide and inspire the collection of information and to promote research in a science which bears so heavily on the production of steel products.

"As a result of this influence the American Society for Steel Treating was formed by joining together the two smaller societies which had organized shortly before. At the time of amalgamation the total membership was 2750. During the past year this has been increased to 3237, a growth of 18 per cent. Local chapters now number 31 as compared with 27 one year ago. Permanent national headquarters have been established and the monthly publication has been made larger and more representative of the field it covers. The organization is in a sound financial condition. All this progress achieved during the past year has been made in the face of unfavorable business conditions. Thus, without doubt greater advancement can be expected with the return of a more normal situation. The society may well take pride in the record it has made."

The *Iron Age* editorial reads as follows:

Progress In Heat Treatment

"If the number of technical and other papers presented at last week's annual convention of the American Society for Steel Treating be the criterion, then progress in heat treatment has been marked in the past year. Over 70 papers were prepared dealing with carbonizing, tool steel, alloy and high speed steel, heat treating problems and equipment, metallographic research and various other subjects. Many of the papers were of a high order and registered a marked advance in the practical and theoretical knowledge of the art. For an

organization only three years old, such an accomplishment is a credit to the enthusiasm of the members and the efficiency of the officials. Few of the older societies could do as well.

"If, however, our measure of the progress in heat treatment be the amount of information actually made public and discussed at the convention last week, the results would not be so pronounced. Without doubt one of the principal benefits of such a convention to those who take the trouble to attend is the hearing and discussion of the largest number of papers possible. The preprinting of a few papers and this followed by a full discussion is productive of the largest measure of profit, in contrast with the presentation by title or verbal abstract of a large number of topics and almost no discussion. The latter was the situation last week. With no papers preprinted and with many of the printed abstracts inadequate, there resulted a distinct disappointment in the lack of opportunity to discuss some of the topics. Another unfortunate phase of such a procedure is that since all the papers are held for publication in the society's monthly journal, many of the important papers cannot be made public until late in the year, and this is naturally a damper on the enthusiasm of some authors.

"There has been marked progress in heat treatment. The co-operation of some of the country's best metallurgists last week and the genuine enthusiasm and interested attendance at the sessions, particularly at those on alloy and other steels, is proof positive of progress in the knowledge of the subject and of a desire for mastery of it by the rank and file."

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ABSTRACTS OF PAPERS PRESENTED AT INDIANAPOLIS CONVENTION

FOLLOWING is an almost complete list of abstracts of papers which were presented at the Indianapolis Convention. The greater part of these papers will appear in TRANSACTIONS during the year.

W. G. CALKINS, Metallurgist, Detroit Twist Drill Co., Detroit, Mich. Paper: *"Notes on Forged High Speed Milling Cutters."*

Abstract:

1. Necessity for a superior grade of milling cutter.
   a. High speed steel specifications; chemical and physical.
   b. Superiority of 18 per cent tungsten high speed steel for drill manufacture.
2. Standard methods of manufacture of milling cutters.
   a. Cutting direct from bar stock.
   b. Upset or method of forging in recessed dies.
3. Structural conditions existing in high speed steel.
   a. In the ingot.
   b. In the billet.
   c. In finished bar stock; large and small rounds.
   d. Carbide segregation.
4. Structural condition in cutters made from large high speed rounds, illustrating coarse crystalline condition indicative of lack of sufficient reduction and mechanical working.
5. Structural condition in cutters upset from bar stock in recessed dies showing fine grained compressed condition existing at periphery.
6. Effect of forging high speed cutter discs between flat hammer dies.
7. Modern design for efficient high speed side milling cutters.
8. Results of milling test; forged versus bar stock cutters at equivalent rates of feed and speed cutting forged chrome nickel blocks of 230 Brinell hardness.

A. H. d'ARCAMBAL, Metallurgist, Pratt & Whitney Co., Hartford, Conn. Paper: *"Physical Tests on High Speed Steel."*

Abstract: Transverse tests at room temperature and tensile tests at temperatures ranging from room temperature to 1200 degrees Fahr., were conduced on two types of high speed steel, namely, the 18 per cent tungsten, 1 per cent vanadium type, and the 14 per cent tungsten, 2 per cent vanadium grade. The specimens were given different hardening treatments, and after being tested, the fractures were examined, samples file tested, and micrographs made on samples given the various heat treatments.

The transverse tests showed that samples quenched from a high temperature and drawn to 1100 degrees Fahr. possessed the necessary hardness and gave a high fiber stress, showing almost double the strength of specimens quenched from the same temperature and not drawn. Quenching into a bath at 1100 degrees Fahr. and not drawing, gave about the same fiber stress and exactly the same microstructure as samples quenched into oil and not drawn. Several specimens in the undrawn condition could not be tested, due to the presence of grinding cracks caused by strains in the material.

Tensile test specimens, quenched from a high temperature, and drawn to 1100 degrees Fahr., showed the maximum tensile strength when pulled at 600 degrees Fahr. Specimens quenched from the high temperature and not drawn, gave about 70 per cent of the tensile strength of samples quenched from the same temperature and drawn to 1100 degrees Fahr. before being tested at room temperature. Specimens given the high quenching treatment, but only drawn to 450 degrees Fahr., possessed only a slightly

higher tensile strength than specimens in the undrawn condition.

The higher vanadium type of steel gave lower transverse and tensile readings than the 18 per cent tungsten grade. This was due to some extent to the former type of steel not standing as high a quenching temperature as the higher tungsten type of steel, thus being slightly overheated, as shown by the fractures.

A. W. F. GREEN, Metallurgist, John Illingworth Steel Co., Philadelphia, Pa. Paper: *"Providing Properly Rolled Tool Steel for the Steel Treater."*

Abstract: A discussion of the production of tool steel. The chief consideration of the steel mill is the production of a tool steel or steels which will be uniform and meet the repeated demands of the consumer. This can be accomplished by the correct supervision of the mechanical working and heat treating of the material before it leaves the steel mill. The steels discussed are straight carbon tool steels, a few of the alloy steels with the exception of high speed steel.

Hammering of the steel is considered and the process is divided into two operations. The first of these is cogging down to a size and shape which can be readily used in the steel mill or under smaller hammers. The second is the finishing temperature. The cooling of the steel after hammering is discussed in an effort to show that the best tool steel is produced by applying special heat treatment to the finished pieces rather than by allowing the pieces to cool in the air, or in lime, ashes, etc., from the finishing temperature.

Rolling of the steel is considered and emphasis is placed on the need of care in heating for rolling and the finishing temperature of the steel as it leaves the mill. Efforts are made to establish the depth to which the rolling and hammering effect the structure of the steel and several drawings are shown, illustrating this point.

The conclusions drawn are that by proper supervision of materials and processes entering into the production of tool steel, together with consideration of the human element, that it is possible to produce a uniform grade of tool steel which is best suited to the particular users of the steel. The paper is illustrated by photomicrographs and drawings.

L. K. MARSHALL, Metallurgist, North East Electric Co., Rochester, N. Y. Paper: *"Tool Steel Manipulation."*

Abstract: The paper presented deals with the most important points met with in the scientific heat treatment of tool steel. Emphasizing that specialization in the heat treatment of tool steel is as important as specialization in production methods. Methods of handling the product of a tool room are discussed. All raw stock is checked to make sure that it will respond to heat treatment. The use of the spark test in checking types of steels used is described. Such points as design, annealing, and plugging of holes must be considered before the work enters the furnace. Breakage and warpage are caused by uneven heating in the vicinity of the critical range. Procedure in use of the electric furnace is followed through. Badly strained pieces are preheated to around 900 degrees Fahr. Work is placed in furnace the temperature of which is below the critical range of the steel being treated. The work is never allowed to become cold in the quench. Tempering is done immediately. Mechanical characteristics of the heat treated product are checked before delivery back to the tool room. The heat treatment of high speed steel in the electric furnace is described. The optical pyrometer is used. Summary.

M. H. MEDWEDEFF, Met. 5014 Weseley Ave. Howard Park, Baltimore, Md. Paper: *"Heat Treatment and Uses of High-Speed Steel."*

Abstract: The various steps in the heat treatment of tool steel are taken up and discussed in detail. Production methods of heat treatment are also taken up.

Attention is called to the indiscriminate use of high speed tools

for both roughing and finishing operations and the fallacy of this procedure is pointed out.

T. HOLLAND NELSON, Steel Works Mgr., H. Disston & Sons, Philadelphia, Pa. Paper: *"A Comparison of American and English Methods of Producing High Grade Crucible Steels."*

Abstract: The above paper deals with the Tool Steel Industry, commencing as an introduction with the days prior to the introduction of the Crucible Steel Furnace. The method of producing Shear and Double Shear Steel is detailed and a fine example of an old 18th Century Hammer under which Shear and Double Shear was made a 100 years ago is reproduced in the form of a lantern slide.

The author compares the English coke hole furnaces and clay pots with the regenerative American gas furnaces and plumbago pots and shows many striking contrasts in methods of production. Interesting details are given of the relative mixes of the Sheffield clay pots, the life of the furnaces and the general routine of our competitors in England.

In the general deductions the author claims that although the object is the same in both countries the method of production differs in many respects and hopes that his paper may give some of those interested a few points from the Sheffield industry which could be readily adapted in American practice with ultimate gain in the quality of the finished article.

The author frankly praises the American methods of production but equally frankly points out how some of the natural resources in England, and apparently minor details affect the finished product.

A. S. TOWNSEND, Chief Chemist, Cleveland Twist Drill Co., Cleveland. Paper: *"The Effect of Tungsten Content on the Specific Gravity of High Speed Steel."*

Abstract: The effect of tungsten content on the specific gravity of high speed steel is discussed and figures are given which show that the specific gravity increases directly as the tungsten content increases, other elements being constant. This rule holds for annealed chrome-tungsten-vanadium steels of the most common type. A simple and rapid method for determining the approximate tungsten content of steels of this type is proposed and explained in detail. The apparent specific gravity is determined and from this result the percentage of tungsten is calculated directly. A table is given showing the tungsten content corresponding to a given specific gravity.

R. L. DOWDELL, Instructor of Metallography, University of Minnesota, St. Paul, Minn. Paper: *"Reclaiming High Carbon Gears"*

Abstract: A tractor company turned out a large number of splined jack-shaft gears which with ordinary heat treatment were so hard and brittle that they would fracture on being tapped with a hammer.

Microscopic examination revealed the fact that instead of being lightly carburized they had been very heavily cased. The core should have run 0.20 per cent carbon and in many cases it ran 0.75 per cent.

A heat treatment was worked by which the core of these gears was rendered soft and tough and the outside made sufficiently hard for the purpose for which they were intended.

Photographs and photomicrographs are given showing the structure of the samples treated.

J. P. GILL and L. D. BOWMAN, Metallurgist and Asst. Metallurgist, Vanadium Alloy Steel Co., Latrobe, Pa. Paper: *"Metallography of High Speed Steel."*

Abstract: A discussion and review is given of the work of previous investigations on the same subject.

A discussion illustrated with slides is given of the critical points in highspeed.

A microstructure of high speed steel may be developed by

using a 1 per cent to 4 per cent nitric acid solution, an alcoholic solution saturated with picric acid, a 10 per cent solution of hydrogen peroxide and sodium hydrate, an alkaline solution of ferricyanide, and by heat tinting. Illustrated.

The microstructure of hardened and tempered high speed steels bear such a close resemblance to carbon steels in the hardened and tempered state that we are justified in using the same nomenclature. Illustrated.

The exact chemical composition of the matrix and of the embedded carbides or tungstides has not been conclusively proven.

The globules or beads as embedded in high speed steel are of a complex but similar chemical composition, and in view of the evidence presented probably should be called tungstides.

The larger percentage of the chromium is contained in the matrix of the steel which at high temperatures seems to give it a greater dissolving power.

A proportionally greater amount of tungsten is contained in the embedded tungstides than in the matrix.

The tungstides bear evidence of being of a eutectic composition.

The distribution of the carbides or tunstides in high speed steel is not only dependent on the amount and manner of the reduction of the ingot, but also upon the casting temperature and rate of cooling of the ingot.

Secondary hardness is a natural phenomenon and is dependent on the carbon, tungsten, chromium content.

N. B. HOFFMAN, Metallurgist, Colonial Steel Co., Pittsburgh, Pa. Paper: *"Ghost Lines and Grain Elongation in Hot Rolled and Cold Drawn Low Carbon Steel Wire."*

Abstract: This paper was prepared to try to show the occurence and difference between an elongated grain structure due to cold work, and a "ghost line".

I have first taken up elongated grain structures aad have endeavored to show the comparison and proofs by submitting micrographs of drawn material after each draft, from one to ten. Then heat treating the grain elongated brittle wire, to show the complete crystallization of the grain structure without any inclusions of sonims. A section of wire is also shown containing the internal "cup" fracture due to over drawing and cold work.

The second wire was heat treated containing "ghost lines" and shows the ferrite grain structure breaking up and recrystallizing, but still retaining an area of sonims high in phosphorus and sulphur running through the grain structure and producing lines of weakness in the metal. Unusual grain growth is also shown caused by them holding phosphorus in solid solution Stead's Copper Reagent is used to show the outline of the "ghosts" due to the fact that areas low in phosphorus are precipitated with copper first, and as soon as the areas low in phosphorus are coated, the specimen is washed and micrographed, showing the outline of the "ghosts" high in phosphorus, to which the copper has not adhered.

I. H. COWDREY, Professor of Mechanical Engineering, Massachusetts Inst. Tech., Cambridge, Mass. Paper: *"The Efficacy of Annealing Overstrained Steel."*

Abstract: Steel is composed of granules of crystalline material inclosed in thin envelopes of non-crystalline or "Amorphous cement." This "amorphous cement" is hard and strong but brittle, and tends to impart properties to the metal in proportion to the quantity present.

During overstrain motion occurs between adjacent portions of the granules, which results in the transformation of some of the originally crystalline metal into the amorphous state. Hence, over strained steel becomes harder and more brittle hence less

resistant to shock. These are undesirable properties. It is customary to anneal many steel parts periodically.

Tests have been made to prove the efficacy of such treatment and the results lead to the following conclusions:

1. Overstrain of metal when its temperature is below the transformation range, results in the production of undesirable properties tending to render the metal unfitted to withstand sudden and shock loads.

2. If possible such effects should be eliminated for the safety of those using devices which have been so abused.

3. Proper annealing suffices to completely restore the normal properties of low carbon steel even after the most severe overstrain.

L. S. COPE, Metallurgical Engineer, Dannemore Steels, Inc., New York. Paper: *"Coarse Grained Forgings; Their Detection and Correction."*

Abstract: Many forgings fail due to the fact that they possess a very coarse grain structure. The manufacturer of the forgings blames the steel maker for this condition while the steel manufacturer in turn blames the heat treater. As a matter of fact it is the forger who is to blame in a great many cases.

The forging process is described in detail and the factors governing the grain size of the finished product are considered.

Methods of detecting coarse grained forgings are next taken up. Several well known methods are possible but all involve the destruction of the forgings. The writer, however, has hit upon a method which does not destroy the product and which may be used on a production basis. It consists in dipping polished portions of the forgings in dilute HNO_3 and noting the appearance of the wiped surface. This, however, does not put a stop to the production of coarse grained forgings.

Coarse grained structure in forgings may be greatly reduced by (a) the use of annealing and normalizing operations on pieces which must be heated to very high temperatures to properly carry out the forging process and (b) the intelligent designing of forging furnaces. These matters are discussed in detail.

E. J. JANITZKY, Metallurgist, Illinois Steel Co., South Chicago, Ill. Paper: *"A Contribution to the Problem of the Influence of Mass on Heat Treatment."*

Abstract: The present paper is a mathematical analysis of the test results obtained in an investigation conducted on 0.45 per cent carbon steel by the British Engineering Standards Association.

By application of mathematic principles to the above mentioned data it is possible to correlate hardness with the diameter of the heat treated bars both in the quenched and the drawn condition. From the equation thus established it is possible to predict what the hardness of bars of any given diameter will be when given the heat treatments used in these experiments.

T. D. LYNCH, & W. J. MERTEN, Met. Engrs. Material & Process Eng. Dept., Westinghouse Electric & Mfg. Co., Pittsburgh, Pa. Paper: *"Tests Showing the Effect of High Temperatures on Malleable Iron."*

Abstract: This paper describes an experiment carried on relative to annealing malleable iron which shows that white iron must be heated above its critical range in order to properly malleablize and that iron high in sulphur shows a much higher critical range than the lower sulphur iron. It also described tests covering the heating of malleable iron for the purpose of straightening warped castings and demonstrates that this can be done provided the temperature is kept below the critical range.

W. J. MERTEN, Met. Engr., Westinghouse Electric & Mfg. Co., Paper: *"A Coiling and Heat Treating Plant for Helical Springs."*

Abstract: The paper forcibly points out the necessity for utilizing adequate coiling and heat treating processes if a high standard in

spring performance is to be attained.

A detailed discussion is given of a plant in which the spring materials are constantly under technical control, without increasing the cost over that of springs now produced by antiquated methods.

W. P. PRIESTLEY, Supt. of Hot Metal Div., U. S. N. O. P. Charleston, W. Va. Paper: *"Fracture Test on Steel to Determine its Quality."*

Abstract: In a short article of less than one thousand (1000) words, a description is given of an inexpensive fracture test for steel forgings, blooms, billets, or bar stock, for the purpose of determining flake, slag, blow holes, or pipe in the steel.

Photographs showing specimen discs are furnished.

Results are also furnished of physical test bars which corroborate the data and information disclosed by the fracture tests.

W. R. WARD, Metallurgical Engineer, Lyells, Va. Paper: *"Miscellaneous Heat Treating"*.

Abstract: The article touches on the following points:

A comparison of quantity production and miscellaneous heat treating.

Difficulties in treating small quantities requiring pack hardening.

Substituting a hardening steel in the place of mild steel used in pack hardening.

Warping and tolerances.

Protecting small parts of large tools when heated.

Modern instrument and the human element.

Work of skilled treaters.

Fractures and Metcalf bars.

Sand blasting tools.

Tempering.

Getting acquainted with the fellow who uses your treated work.

Cemented high speed tool bits on cheap steel shanks.

The varied work handled.

W. H. WHITE, Supt. of Melting Shops. U. S. N. O. P. Charleston, W. Va. Paper: *"Heat Treatment of Steel Castings"*.

Abstract: This paper touches on the necessity of the steel treater to familiarize himself with the melting and shaping of steel, that further knowledge may be imparted to him in the execution of his profession; the classification of castings as to composition and size; the value of good records through all operations and inherent defects that should be studied for the determination of certain treatments; the use of scientific instruments and certain simple tests that assist in treatment determination.

C. M. CAMPBELL, Supt. Pioneer Alloy Products Co., Cleveland, O. Paper: *"Do Alloy Carbonizing Boxes Pay?"*

Abstract: The factors which tend to increase the life of carbonizing boxes are:

1. Critical points at or below average atmospheric temperatures.
2. Low co-efficient of expansion and contraction at high temperatures.
3. Good elastic limit and ductility at high temperatures.
4. Tendency to resist carbon absorption up to and including temperatures of carbonization of steel.
5. Resistance to oxidation.

The alloy possessing most of these features is one having a nickel base but this is very expensive.

Several attempts have been made to produce a less expensive alloy from an iron, chromium base but thus far these have not been very successful.

The use of the alloy carbonizing box in the jobbing and the specialty shop is discussed both from the standpoint of shop practice and from the standpoint of cost.

H. H. HARRIS, Pres., General Alloys Co., Chicago, Ill. Paper: *"Design of Heat Treating Containers."*

Abstract: The design of carbonizing containers is one of the most vital features of the pot and box problem. Furnace capacity, heating time, fuel bills and uniformity of product are largely determined by the design of the container. The ratio of carbonizing compound to pounds of steel carbonized is directly controlled by the design of the container.

Carbonizing containers should be designed with the following points in mind:

1. The dimensions of the parts to be treated. 2. The dimensions of the furnace. 3. The number of parts to be placed in each container, and the number of containers to be placed in each furnace. 4. The weight, wall section and conductivity of the containers. 5. The flange design and method of sealing. 6. Legs for heat circulation and lugs for handling. 7. Methods of handling. 8. Methods of cooling.

The dimensions of the parts to be treated limit the inside dimensions of the container, and the dimensions of the furnace limit the outside dimensions. The number of parts can generally be varied and packed either vertically, horizontally or in combination. The number of boxes can generally be varied and placed in different combinations in the furnace. It is desirable to get the largest possible cubical box content into the furnace with due regard to flue space for heat circulation.

This paper deals with various designs of containers, methods of sealing, etc., and with the variables that are affected by container design.

V. E. HILLMAN, Metallurgist, Crompton & Knowles Loom Works, Worcester, Mass. Paper: *"The Efficiency of Various Mixtures for Cyanide Hardening and The Role of Nitrogen in the Process."*

Abstract: The author deals with the efficacy of cyanide hardening mediums. Curves have been plotted to show the depth of "case" incident to the use of the subject mixtures.

Several paragraphs have been devoted to cyanide containers, the fume nuisance and testing. The presence of nitrogen is discussed both from the standpoint of chemical and microscopic examinations. The micro-appearance of the unhardened case is described in detail particularly with reference to the formation of a special constituent known as "Flavite."

W. I. McINERNY, Foreman Heat Treat. Armor Plate, U. S. N. O. P. Charleston, W. Va. Papers: *"Carburizing Heavy Sections."*

Abstract: A short paper on carburizing heavy sections four to thirteen inches in thickness, giving the results of different experiments in carburizing showing an increase in carbon or case from surface to a depth of two inches.

H. SCHAGRIN, Ch. Chemist, U. S. N. O. P. Charleston, W. Va. Paper: *"Carburization with Wood Charcoal."*

Abstract: In this article the effects of carbonization at temperatures varying from 1400 degrees to 2000 degrees Fahr. using wood charcoal only as carbonizing agent are brought out. Temperature control was effected by means of thermocouples inserted in the center of the boxes. Some chemical reactions attending carbonization are discussed. The experiments were carried on on a production basis in semi-muffle type furnace of the same size regularly used for production work.

It is concluded that for a normal rate of penetration of approximately 1/16 inch, and where this can be accomplished during a period of from one to one-half hours, wood charcoal will serve the purpose.

P. W. & E. B. SHIMER, Metallurgical Engrs., Easton Pa. Paper: *"Cyanamid in Liquid Case Hardening."*

Abstract: This paper amplifies and brings down to date the description by Professor Joseph W. Richards of "The Shimer Case Hardening Process" read by him before the New York Meeting of the American Institute of Mining and Metallurgical Engineers in February, 1919.

The process has now been in continuous and successful use for nearly five years.

The harmlessness of the gases evolved has been demonstrated by the collection and analysis of samples. They are a mixture of nitrogen, carbon monoxide and a little carbon dioxide; no trace of cyanogen could be collected from a sample of six liters. The carbon monoxide burns to carbon dioxide on the surface of the melt, leaving only perfectly harmless gases to escape into the air.

With carefully selected lump calcium cyanamid and the inert mixture of salts with which it is used case-hardening is done at the usual temperatures and, if desired, at higher temperatures, such as 1650 degrees Fahr. and even 1700 degrees Fahr. It is possible to get about 1/32-inch case in 1½ to 2 hours at the higher temperatures.

S. C. SPALDING, Metallurgist, Halcomb Steel Company, Syracuse, N. Y. Paper: *"Comparison of the Rate of Penetration of Carbon Into Various Commercial Steels Used for Case Carburizing."*

Abstract: Brief introduction and reference to standard authorities on the subject.

Types of steels investigated comprise plain carbon, cold rolled, chrome silico manganese, chrome vanadium, 3½ per cent nickel, 5 per cent nickel, two types of chrome nickel and a chrome molybdenum.

Test bars were run for periods of 5, 10, 15, 20, 25, 30, 40, 50 and 55 hours at 1600 degrees Fahr. and 1700 degrees Fahr. allowed to cool in pots then the depth of case measured by the microscope. Some of the typical test pieces were given different heat treatments to show their effects on case and core. Time penetration curves for each temperature and each steel are given with a combined sheet showing all steels plotted to same coordinates for one temperature. Complete series of photomicrographs of all steels at different times and temperatures are given with explanatory discussion.

A. E. BELLIS, Pres. Bellis Heat Treating Co., New Haven, Conn. Paper: *"Influence of Heating Medium on Structural Changes in Steel."*

Abstract:

1. Metallurgical objectives in treating steel.
   Importance of rate of heating and cooling, and time effect in hardening and tempering.
2. Consideration of properties of gaseous, liquid and solid heating medium, specific heats, heat conductivity and heat convention, "Quantity" of heat.
3. Particular considerations of different liquid heating media and their effect on transferring heat to different steels.
4. Practical application of these facts to treatment of high speed steel.
   A method for complete transformation in hardening.
   The "quantity" of heat required for transformations.
   Effect of rate of cooling.
   Obtaining maximum rate at various temperatures.
5. Tests and performance records of cutting tools.

A. A. BLUE, Metallurgist, Duff Mfg. Co., Pittsburgh, Pa. Paper: *"A Successful Bonus System Applied to Heat Treating."*

Abstract: The requirements for a successful bonus system are

(1) the figures must be easily and cheaply calculated and they must be accurately obtained; (2) the flexibility of the organization must not be greatly affected by such an installation; (3) it should cover a wide range of products; (4) it must obtain co-operation between all employes, those on the same shift and those on all shifts; and (5) complete records must be kept of all details, preferably by the men themselves.

The system used by one eastern manufacturing concern is based on both quality and quantity demands. The bonus is allowed to heaters on the basis of (a) the accuracy of control of furnace temperatures and (b) time required per heat. The bonus is allowed to helpers on the basis of material handled per unit time. The unit used is pounds per furnace hour.

The system has proven very satisfactory both to employers and employes.

J. WALTER BRESSLER, Philadelphia, Pa. Paper: *"System of Records for Metallurgical Departments."*

Abstract: An accounting system is described by means of which the inspection and chemical analysis of each lot of steel received is recorded. The system also includes the record of heat treatment, physical tests and final inspection. These records are so arranged that they may all be conveniently filed with the orders for finished products.

The various printed forms used in this system are included in the paper.

W. E. JOMINY, Met. Studebaker Motor Car Co., Detroit, Mich. Paper: *"The Selection of Steels for Automobiles."* Trans. A.S.S.T. Vol. 1, Dec. 1921 p. 206-12

Abstract: The present paper is divided into two parts namely:

(a) Factors governing the proper selection of a steel for a given part.

(b) Steel commonly used in present day practice.

In section (a) the various factors entering into the selection of steel are considered such as elastic limit, ductility, resistance to wear, machinability and cost.

In section (b) twelve types of steel are described which cover every need of the automobile engineer in designing a motor car.

E. W. PIERCE, Metallurgist, Maxwell Motor Car Co., New Castle, Ind. Paper: *"Buying Steel on Closer Carbon Limits."*

Abstract: This paper consists of an argument for the buying and-selling of steel on a five point carbon limit, instead of the present method of a ten point variation. It deals with the argument from the standpoint of the fabricator who is required to forge, heat treat and machine for a finished product.

Particular attention is given to shop troubles arising from heat treated material of a wide variation, as regards production and costs. It covers difficulties arising in case hardening as well as heat treating when traced to varying carbon content. Mill practice to produce this desired limit is suggested.

C. F. SMART, Asst. Ch. Metallurgist, Ingalls-Shepard Div. Wyman-Gordon Co., Harvey, Ill. Paper: *"Steel Is Steel."*

Abstract: Instances are given illustrating losses resulting from use of steel of wrong composition, due to improper segregation of stock. Data, summarized and plotted, from over six hundred tests covering more than one hundred heats of 1045 steel shows a wide distribution of physical property values obtained in the application of like heat treatment to stock of similar composition. This, with other tests and a study of Brinell tests on many thousands of heat treated forgings leads to the belief that about 70 per cent practice can be consistently maintained on carbon steel forgings from mixed heats, heat treating to a Brinell range of 0.3 mm.; while if such stock be checked by chemical analysis, segregated, and treated by individual heats, according to treatment

determined by previous metallurgical tests, a practice of 99 to 100 per cent can be maintained. Such evidence fortifies the conclusion that for utmost of profit and satisfaction steel requires study and investigation, separation and selection, carefulness in handling, judgment in choice of stock, determination of proper treatment and accuracy in carrying out that treatment.

W. P. WOOD, Professor of Chem. Engineering, University of Michigan, Ann Arbor, Mich. Paper: *"A University Course in Metallurgical Engineering."*

Abstract: A four year course leading to some such degree as Bachelor of Science in Metallurgical Engineering is presented. The object in mind has been the preparation of students not so much in the mining and mill end of metallurgy as in that part of the science which has to do with the final fabrication and preparation of metals and alloys for use. This is largely the result of the fact that the writer's work and experience has been in the vicinity of the center of the automobile industry where the object stated above would have particular application, and because of the fact that most of the older courses in metallurgy put no more stress upon the final preparation than upon the mining and mill end of the industry.

The writer's defense of this procedure is the belief that any university, particularly state universities should serve the part of the country which is contributing most largely to their support and that the courses taught therein should place emphasis upon those phases of industry which are most important in the territory which the university serves.

H. F. WOOD and F. G. MILLARD, Ch. Metallurgist, and Supt. of Finishing Dept., Ingalls-Shepard Division, Wyman-Gordon Co., Harvey, Ill. Paper: *"Determination of Heat Treating Costs."*

Abstract: Paper covers the importance of proper cost determination in the heat treating department, and the importance of supplying foremen with proper monthly reports.

Gives a detailed analysis of costs, bringing out the items that constitute burden and shows how the burden is distributed on the equipment in the form of furnace hour rates.

The method of collection of cost data is given in detail as well as the method of determination of actual costs from the data collected.

Paper is finished by discussion on the effect of proper cost analysis in the heat treating department.

H. J. FRENCH, Physicist, Bureau of Standards, Washington, D. C. Paper: *"Tensile Properties of Some Structural Alloy Steels at High Temperatures."*

Abstract: The report gives results of determination of tensile strength, proportional limit, elongation, reduction of area and strength at fracture throughout the range 20 degrees to 550 degrees Cent. for four steels containing about 0.38 per cent carbon, as follows:

(a) plain carbon steel.
(b) 3½ per cent nickel steel.
(c) 3 per cent nickel, 1 per cent chromium steel.
(d) 1 per cent chromium, 0.20 per cent vanadium steel.

Brief reference is made to the type of fractures obtained in testing steels at various temperatures and particular attention is paid to comparison of the tensile properties of these alloys at 550 degrees Cent.

M. A. GROSSMAN, Metallurgist, Electric Alloy Steel Co., Youngstown, O. Paper: *"The Toughness of High Speed Steels as Affected by Their Heat Treatment."*

Abstract: Data are presented constituting the results of toughness tests on two high speed steels of common analysis. The tests were carried out on an impact machine of the Charpy type, on test bars which resembled the standard Charpy bar, unnotched.

A considerable number of test pieces were hardened and

drawn, covering the quenching range from 1700 to 2250 degrees and the drawing range from no draw to 1100 degrees. For each quenching temperature a series of test pieces was drawn at all the drawing temperatures. It was found that there is a certain quenching temperature slightly below the proper hardening range for which the steel is brittle on being quenched and acquires no toughness on being drawn up to 1100 degrees. Below this quenching range, drawing imparts toughness but lowers the hardness. Above that range, drawing at 1100 degrees imparts toughness while at the same time developing secondary hardness. The toughness tests and the hardness tests were carried out on the same test pieces.

Curves are given showing the changes in toughness for the different heat treatments and the change in scleroscope hardness for those heat treatments. The data show:

(1) That the development of secondary hardness in the proper hardening range is accompanied by an acquiring of toughness which may properly be called "secondary toughness," and

(2) that just below the proper hardening range there is a range of temperature which, while giving quite good hardness, results in the steel being brittle and remaining so even with subsequent drawing to 1100 degrees.

C. M. JOHNSON, Director of Research, Park Works Crucible Steel Co. of America, Pittsburgh, Pa. Paper: *"Some Alloy Steels of High Elastic Limit, Their Microstructure and Heat Treatment."*

Abstract: The report gives the results of heat treatment and physical tests on a series of alloy steels of high elastic limit. The following steels were investigated:

1. A nickel-silicon steel.
2. A nickel-silicon steel containing small amounts of chromium and vanadium.
3. Same as No. 2 but containing small amounts of titanium.
4. Same as No. 2 but containing small amounts of zirconium.
5. Same as No. 2 but containing small amounts of tungsten.
6. Same as No. 2 but containing small amounts of molybdenum.

Micrographic studies were also made on these steels and are included in the report.

G. C. McCORMICK, Asst. Metallurgist, Crompton & Knowles Loom Works, Worcester, Mass. Paper: *"A Discussion of Uranium and Allied Elements."*

Abstract: The paper discusses the beneficial effects of uranium firstly as a scavenger and secondly as an alloying element.

The writer presents a Metallurgical Provision Chart which groups the alloying elements according to the location of their melting points and according to the manner in which they augment the physical properties of steel.

The chart presents three characteristic groups which show omissions which appear to be prophetic of what may be expected in the line of future metallurgical developments.

H. STYRI, Chief of S. K. F. Research Laboratories, Philadelphia, Pa. Paper: *"Heat Treatment of Chrome Steel for Ball Bearings."*

Abstract: The material used in the production of balls is described.

The proper conditions for hardening of this steel is discussed and the phenomena generally accompanying hardening are described. Special attention is given to the effect of varying the cooling rate. Several very interesting abnormalities in hardening are described.

A considerable number of photomicrographs are shown illustrating the above mentioned features.

J. S. VANNICK, Metallurgist, Research Laboratory, Department of Agriculture, Washington, D. C. Paper: *"The Mechanical Properties of Some Chrome Vanadium Steels."*

Abstract: 1. The mechanical properties such as tensile strength and

hardness of a series of chrome-vanadium steels was determined. The series were divided into 3 groups as follows:

	C	Va	Cr. Varying from
Group I	.30-.40	.14-.20	0.0 to 14.5
	C	Cr	Va varying from
Group II	.30-.40	1.0	0.0 to .65
	Cr	Va	C varying from
Group III	1.0	.20	.15 to 1.20

2. In group I, the increasing chromium gradually increases the tensile strength and hardness up to 2 per cent. Cr. Above 2 per cent Cr. the tensile strength increases rapidly, but the ductility is slightly decreased. In the heat-treated condition the same effects are greatly intensified.

3. In group II, the effect of vanadium within the range investigated is not marked in the annealed steels. In the heat-treated set, a sharp increase in tensile strength appears as vanadium is increased from .30 to .65 per cent. The ductility of this steel (.65 Va) is slightly lowered.

4. In group 4, an increase in carbon increases the tensile strength and lowers the ductility of the annealed steels. In the heat-treated specimens a similar effect occurs up to .60 per cent C. at 1.20 per cent C. (carbon) the tensile strength falls and the steel becomes brittle.

5. From a summary of the data, chromium up to 2 per cent improves the tensile and hardness properties of a carbon-vanadium steel; vanadium exerts no appreciable effect in a chrome-carbon steel; carbon up to .60 per cent increases the tensile strength of a chrome-vanadium steel; at 1.20 per cent a preceptible decrease in strength and ductility is noticeable.

6. The results of fracture tests made to determine the quenching ranges are compared to the position of the critical points of the steels as determined by thermal analyses.

7. The microstructure of the different steels is described and micrographs typical of the steels in the heat treated condition are included.

R. M. BIRD, Metallurgist, Bethlehem Steel Co., Bethlehem, Pa. Paper: *"Standardization of Methods Leading to Comparative Physical Properties of Alloy Steels."*

Abstract: There is a large and ever increasing demand for accurate knowledge on the matter of proper heat treatments and physical properties of alloy steels. The Steel Standards Division of the American Society of Automotive Engineers has done a great deal on the subject and their efforts will be of great value when complete. However much remains to be done.

At a plant of one of the large steel companies data of this sort has been accumulated for many years. A very complete procedure has been worked. After proper inspection, 4-inch x 4-inch billets are rolled into 1-inch rounds. These in turn are inspected and analyzed after which critical points are run on them. The bars are then normalized and given a wide range of heat treatments after which they are pulled on a testing machine. Both Brinell and scleroscope hardness are taken. The results are plotted on convenient forms.

Data on bars larger than the 1-inch rounds are as yet not available.

A. M. COX, Asst. Metallurgist, R. D. Nuttall Co., Pittsburgh, Pa. Paper: *"The Abrasive Qualities of Plain Carbon and Alloy Steels."*

Abstract: The paper covers a large number of tests that have been made on steels of different quality and different heat treatment, to determine the relative wear as effected by steels that rub, one against the other.

The material used in the abrasive tests were subjected to chemical, static tension, and brinell hardness tests. Microphotos were also taken of one specimen from each test group.

The steels tested were plain carbon and chrome nickel. In the annealed, heat treated and carbonized condition. The test

results indicate that:—The greater the density and hardness, the greater the abrasive resistance. Also that the ordinary tension and brinell tests are not a reliable index to the abrasive qualities of a material.

The carbon steel showed more uniform results than the chrome nickel steel and greater average wear, with similar density and hardness.

H. J. FRENCH and W. G. JOHNSON, Physicist and Asst. Physicist, Bureau of Standards, Washington, D. C. Paper: *"Effect of Heat Treatment on the Mechanical Properties of One Per Cent Carbon Steel."*

Abstract: The effects of varying time-temperature relations in heat-treatment on tensile and impact properties, hardness, and structure of one per cent carbon steel have been studied, including (a) effect of temperature variations in hardening (b) time at hardening temperatures both above Acm and between the Acl and Acm transformations (c) effects of tempering steel hardened in different ways and effects of "soaking" just under the lower critical range (d) comparison of oil and water hardening for production of definite strengths.

H. A. HOLZ, Pres. Holz & Co., New York. Paper: *"Recent Researches on the Elastic Limit."*

Abstract: To the constructive engineer the most important physical property of steel is its "limit of proportionality" or, as this limit is alternatively called, the "true limit of elasticity." Up to this limit the extension is proportional to the load which produces it. Beyond this limit the extension increases at a greater rate than the load, and the material no longer shrinks to its original dimensions after the load is removed, but retains a permanent set. The "yield load" determined in the usual routine testing of steel is not the limit of proportionality, nor is this limit any constant fraction of the yield load.

The reason why the limit of proportionality has not been one of the data included in the usual routine and commercial tests of steel is that by the methods and instruments heretofore available for real accurate work, the observations are tedious and the time required in making these observations and subsequently alotting them is so considerable that the cost has been prohibitive.

The limit of proportionality and other elastic constants can now be accurately determined, automatically and so quickly that there is no reason why these important constants should not be included in the routine testing of steel.

Our present "tensile tests" are crude and do not disclose defects in steel which are often of great importance, such as notch-brittleness. The instrument described produces automatically accurate and complete "load-extension diagrams" and differentiates clearly between steels of different impact values. It seems that the diagrams obtained by this apparatus will also show the positive value of the fatigue limit.

L. W. WILD, Pres., Wild Barfield Co., London, England. Paper: *"Influence of Heat Treatment on the Magnetic Properties of Steel."*

Abstract: The object of the investigation reported in this paper was to determine the changes in the intensity of magnetization and coercive force when samples of hardened steel were reheated to various temperatures and slowly cooled.

The following samples were tested: Swedish iron, low, medium and high carbon steel, and chrome, nickel and tungsten alloy steels. After quenching these samples were reheated to varying temperatures (from 100 degrees Cent. to 1100 degrees Cent.) and the magnetic changes determined.

The results are plotted as curves.

H. J. FRENCH, Physicist, Bureau of Standards, Washington, D. C. Paper *"Effect of Heat Treatment on Mechanical Properties of a Carbon Molybdenum and a Chrome Molybdenum Steel."*

Abstract: Thermal transformations of a carbon molybdenum

steel containing 0.20 per cent carbon and about 1 per cent molybdenum and a chromium molybdenum steel of the type 0.27 per cent carbon, 0.9 per cent chromium and 0.5 per cent molybdenum are given for various temperatures of heating and rates of cooling.

The effects of the following variables on the mechanical properties and structure of these steels are discussed.

(a) Variations in normalizing temperatures.

(b) Variations in temperature from which the steels are hardened.

(c) Effects of tempering at various temperatures. Comparison of various methods of heat treatment for the production of definite tensile strength and impact values in the carbon molybdenum steel are also given.

W. H. BRISTOL, Pres., Bristol Co., Waterbury, Conn. Paper: *"Automatic Compensation for Variations in Temperature of Cold Ends of Thermo Electro Pyrometers."*

Abstract: The objects of this paper are to call attention to the importance of properly taking into account the effect of the variations of cold end temperatures of the thermo-electric couple and to describe with illustrations a method of automatic compensation for atmospheric changes of temperature that may occur at the point where the cold end of a thermo-electric couple of a pyrometer is located, so that the readings of the instrument will be correct and independent of such temperature changes.

By means of lantern slides and moving pictures a demonstration will be given to show that the cold end of the thermo-electric couple of a pyrometer may be varied in temperature over a range of 100 degrees Fahr., and still automatically compensate for such a change giving correct temperature indications of the hot end of the thermo-couple, the same as if the cold end had been maintained at a constant temperature, when provided with the automatic compensating device.

E. D. CAMPBELL, Professor of Chemistry, University of Michigan, Ann Arbor, Mich. Paper: *"Some Brinell Hardness Measurements on Small Specimens."*

Abstract: The method of constructing and calibrating a light balance which may be readily substituted for the regular 500 kilogram balance of a standard alpha Brinell machine is described. When the light balance is used with a 2 millimeter ball and a 16 millimeter objective substituted for the 48 millimeter objective of a standard Brinell microscope, the image will appear exactly the same size as that which would be obtained with a 10 millimeter ball under 3000 kilos pressure.

By adding to the light balance, 21 kilos using the 5 millimeter ball and observing the impression with a 32 millimeter objective, the image will correspond with that which would be obtained with the same metal tested with a 10 millimeter ball under 500 kilos pressure.

With this attachment, hardness measurements may be made on quite small specimens with the same accuracy and almost as easily as can be done on large samples working under standard conditions and the same tables of hardness numbers may be used. Illustrations showing the influence of carbide concentration and rate of cooling on the hardness at opposite ends of small bars 6 millimeters square by 15 millimeters in length are given. The results confirming deductions previously made from differences in thermo electro motive potential measurements on similar bars.

KELLER, GEORGE, Sales Mgr. Brown Instrument Co., Philadelphia, Pa. Paper: *"Skipping the A. B. C's to Talk the X. Y. Z's of Temperature Measuring Instruments."*

Abstract: An interesting story is told that the profit in selling incandescent lamps made the Mazda possible. The profit enabled the manufacturer to maintain a research organization. As a result, the public gets three times as much light for the money today.

In the same way research has, in the last twelve months, since

the last show, contributed materially to the betterment of design of everything the steel treater used. A few striking examples are illustrated in this article such as a portable potentiometer with an 8-foot scale, the use of automatic signaling, the heat cycle controller, new cold junction compensation and a little further comment on what may be expected from the research laboratories of such groups of men as the instrument manufacturers.

R. W. NEWCOMB, Mgr., Charles Engelhard, Inc., New York City. Paper: *"A New Type Automatic Temperature Regulator; Its Application to Heat Treating Furnaces."*

Abstract: An automatic temperature regulator to be satisfactory, must possess the following qualities:

(a) Dependability, under which should be included accuracy, constancy, simplicity, and power.

(b) Flexibility, under which should be included adaptability to gas, oil, powered coal, and electric furnaces.

(c) Adjustability. It must be possible to adjust the range, speed and magnitude of control to cover a wide range and also diversified furnace and burner construction.

An instrument which, it is thought, fulfills these requirements is described in detail and its various possibilities discussed.

T. Y. OLSEN, V. P. Tinius Olsen Testing Machine Co., Philadelphia, Pa. Paper: *"Determination of Stiffness of Wire or Sheet Metal."*

Abstract: Methods of inspection of material going into springs has been very much of an approximate process up to the present. In as much as large quantities of spring materials are consumed every year it is highly desirable to have a reliable test to use on such material.

A testing machine which it is thought, fulfills the requirements for such a test, has been designed and is described in this report.

S. P. ROCKWELL, Metallurgist, Whitney Mfg. Co., Hartford, Conn. Paper: *"Testing of Metals for Hardness."*

Abstract: The object of the investigation presented in this report was to compare the results obtained by the Brinell, Sclerescope, and Rockwell hardness testers on various metallic products and under varying conditions.

The instruments were tested out on carbon and alloy steels under several conditions of heat treatment, on nonferrous materials of varying degrees of hardness and on the above materials in the form of tubes, rounds, etc.

The possibilities of converting the readings of any one of the machines over into terms of any of the others is taken up.

The results of tests are shown as curves.

C. UPTHEGROVE, Professor of Chemical Engr., University of Michigan, Ann Arbor, Mich. Papers: *"Note on the Small Brinell Machine."*

Abstract: The Baby Brinell machine is described. Its development has been described by Goodale and Banks in the Development of Brinell hardness tests on thin sheet brass.

This machine has been used for the testing of cartridge brass and other thin sheets, using a 1/16-inch ball and 15 kilogram load. The design does not limit the load or ball to the above sizes but is such as to allow ready substitution of other size balls or loads.

The operation, accuracy, uses and limitations are discussed.

T. F. BAILY, V. P. Electric Furnace Co., Alliance, O. Paper: *"Electric Furnaces for Heat Treating With Automatic Control."*

Abstract: The means by which automatic temperature control is obtained in electric furnaces may be divided into three classes:

(a) Control of the quantity of electricity going into the furnace.

(b) Automatic pyrometer control, which controls the movement of the material through the furnace.

(c) A time element device, making a movement of the material

through the furnace every so many minutes.

The first means of control is only practical on small wire wound furnaces as on large furnaces it would cause such violent fluctuation in power that the price of electricity would be excessive.

The second and third types of control have been found usable on large scale operations. They are free from the objections mentioned in the first case and have been found to give consistent results over a period of several years.

G. R. BROPHY, Metallurgical Engr., Indus. Furnace Dept. General Electric Co., Schenectady, N. Y. Paper: *"Calite; A New Heat Resisting Alloy."*

Abstract: An alloy containing Al, Ni, Fe, which will stand, without oxidation, temperatures up to 1300 degrees Cent. (2372 degrees Fahr.) This material is highly resistant to atmospheric corrosion and the action of acids (except HCl and H_2SO_4). In a concentrated sea salt solution spray at 100 degrees Fahr. this alloy retained a perfect polish after 100 hours. It is unaffected by molten NaCn, $BaCl_2$ or NaCl. Molten or vaporized S does not affect it appreciably.

Physical properties.

Melting p.—1500 degrees-1525 degrees Cent.
Sp. gr.—7.03.
Transverse strength.
1-inch square bar 12-inch sup't.—4250 pounds.
Electrical resistivity—112 ohms per cm^3
Heat resistivity—3.25x that of Ni.
Temp. Coeff.—0.00044

It is forgeable only when handled carefully and by special procedure. After repeated heating and cooling from 1000 degrees Cent. no change took place in dimensions, neither does repeated quenching from this temperature affect the metal.

Any shape which can be cast of steel can be as easily cast of Calite.

E. F. DAVIS, Sales Mgr. Celite Products Co., New York. Paper: *"Construction of Furnace Doors, Lining and Bases."*

Abstract: It is pointed out that furnace construction is one of the most backward branches of engineering science. The reasons for this are pointed out.

The three methods of heat transmission namely conduction, radiation and convection, are taken up and discussed in detail. The calculation of heat losses is taken up and developed fully.

The question of furnace construction is next considered and such questions as the relation of size to fuel consumption, the use of insulation in doors, linings and bases, etc., are discussed.

F. J. EVANS, Sales Eng. Surface Combustion Co., Springfield, Mass. Paper: *"High Pressure Gas and Its Application to Industrial Furnaces."*

Abstract: In the application of gas fuel to industrial plants there are three distinct systems in common use:

(a) Low pressure air and gas systems with two value control and manual proportioning.

(b) Low pressure air and gas system with single value control and automatic proportioning.

(c) High pressure gas system with single value control and automatic proportioning.

The first two systems are open to several objections among which are the fact that very large pipes must be used for the gas and individual blowers are necessary to supply the compressed air.

The third system is open to neither of these objections and in addition has many desirable features which are fully brought out in the article.

J. T. GOWER, Armstrong Cork & Insulation Co., Pittsburgh, Pa. Paper: *"What Insulation Will Do for the Heat Treater."*

Abstract: The benefits which are derived from the use of heat

insulating materials can hardly be over-estimated. A few of the most prominent of these are:

(a) Insulation increases the capacity of equipment with no increase in fuel consumption.

(b) Insulation makes temperatures more uniform in heated equipment.

(c) Insulation decreases the time required to bring equipment to the working temperature.

(d) Insulation, an many cases, lengthens the life of refractories by eliminating the necessity for over heating in the combustion chamber.

(e) Insulation makes more comfortable working conditions by reducing air temperatures around the heated equipment.

The various factors governing heat losses through conduction are discussed and formulated mathematically.

C. L. IPSEN, Designing Engr., General Electric Co., Schenectady, N. Y. Paper: *"The Electric Furnace as it Affects Over-all Cost of Heat Treated Parts."*

Abstract: In the development of steel treating furnaces there has been a progressive change from one form of heat source to another, starting with wood and going on through coal, oil and gas, to electricity. Each change has been to a higher priced fuel, indicating that there are factors more important than fuel costs in steel treating. A table is given showing the over-all cost of several heat treated parts and the percentage of this cost that is chargeable to fuel. A small improvement in quality, reduction in rejections or saving in subsequent operations will in most cases cited many times offset the increased cost of improved heat source.

Electricity is the ideal heat source for steel treating because (1) the temperature of heat source is only slightly higher than parts being treated, so that no part can be overheated; (2) absolute temperature uniformity can be maintained; (3) the human element is reduced by the use of accurate and reliable temperature control.

In the selection of any furnace first consideration should be given to cost and quality of finished part, as it will in most cases show that the highest priced heat source is the least expensive.

P. J. LAFORE, Industrial Eng., Boston Consolidated Gas Co., Boston, Mass. Paper: *"The Use of Gas Fired Furnaces for Heat Treating."*

Abstract: The paper speaks of the need of a suitable furnace in order to properly heat-treat steel, and outlines the more essential features of such a furnace. It compares coal, oil, electric and gas furnaces, bringing out the point that coal and oil are not satisfactory for most purposes. Electricity gives good results but is expensive and slow in coming up to temperature, but where the proper type of gas-furnace is used the results are very satisfactory.

It then goes on to describe some of the requisites of a good gas-furnace and the four general classes of mixing devices that can be used, viz., high-pressure gas system, in which all of the air is drawn in and mixed at the mixing device at the furnace; system where part of the air is mixed with gas away from furnace and is carried under pressure to the furnace where the remainder of the air is drawn in; low-pressure gas system where the air under pressure automatically admits and induces the gas, and the two-valve system where air under pressure inducts the gas by means of a mixing tee.

It then describes a gas installation in a manufacturing plant making jacks, and in a commercial heat-treating plant. In both cases the equipment is all gas, the first using the two-valve system, and the second, high-pressure gas, where all the air is drawn in at the mixing device at the furnace. It describes the kind of work done and the highly satisfactory results obtained.

G. M. LITTLE, Res. Engr. Div., Westinghouse Electric & Mfg. Co., Pittsburgh, Pa. Paper: *"An Electrically Heated Forging and Heat Treating Furnace."*

Abstract: The paper "An Electrically Heated Forging & Heat Treating Furnace" gives an account of the development of a resistance type electric furnace for high temperature work. In it is brought out the remarkable scarcity of materials suitable for constructing a satisfactory heating element or resistor—and the solution of this problem by the construction of a heating element composed of a pile of carbon plates clamped together under heavy pressure and surrounded by a blanket of hydrocarbon vapors.

It is pointed out that, in practically all the present forms of resistor type furnaces, it is not possible to crowd them so as to obtain a large output of heated metal, on account of the melting down of the refractories which support or back up the heating element. This problem was solved by suspending the heating element across the furnace chamber free from the walls or roof—and by the use of a top lining to the furnace chamber composed of bars of carbon covered with a thick layer of coke dust. This roof cannot be melted and is protected from oxidation by the same blanket of hydrocarbon vapors which protects the heating element.

The general description of the final form of a forging furnace of this type is given and some data as to the performance and cost of operation.

A paragraph is given to some interesting results obtained in a small experimental brass melting furnace which was constructed along the same lines as the forging furnace.

W. E. McGAHEY, Foreman, Heat Treating Large Guns, U. S. N. O. P., Charleston, W. Va. Paper: *"Heat Treatment of Large Forgings by Oil, Gas, and Electricity."*

Abstract: Definition of the term "Large Forgings" dividing them into two classes with respect to heat treated quality.

The value of uniformity in heating which is largely dependent upon temperature control and the defects that may result from non-uniformity.

Conditions governing temperature control and the difference in method of control for oil, gas and electric fired furnaces.

The burning and heating efficiency of oil and gas compared with electricity.

Comparative advantages and disadvantages effecting the cost and practicability of oil and gas fired furnaces versus electric.

A. F. MITCHELL, Supt. Heat Treating U. S. N. O. P., Charleston, W. Va., Paper: *"A Comparison of Conditions Entering Into the Operation of Oil and Natural Gas Fired Furnaces."*

Abstract: This paper deals with furnace selection, energy application, fuel mixers, fuel oil, natural gas and the human element is applied to industrial heat treating furnaces.

The information and suggestions are based upon practical experience in the heating of large masses up to fifty tons in weight.

The furnace selection deals with types of furnaces, combustion chambers, heating chambers and refractory materials.

The application of fuel energy is dealt with as applied today in industrial furnaces and suggestions are made for fuel conservation.

Under the heading of fuel mixers the writer calls attention to efficient and inefficient methods of mixing and burning fuels and calls attention to conditions that are to be desired.

The quality of fuel oils, installation required and conditions necessary to secure satisfactory results are briefly described.

Past experiences with regard to the use of natural gas in the industries is referred to and suggestions for its conservation where it is available, are made.

Suggestions are made which if applied would increase the efficiency of furnace operators.

J. WEAVER SMITH, Inds. Engr., Citizens Gas Co., Indianapolis, Ind. Paper: *"Gas Accessories for the Heat Treating Room."*

Abstract: In this article the writer offers a few practical sug-

gestions as to the use of some of the minor gas appliances. He discusses the different methods of heating liquids in large quantities, especially as applied to cleaning solutions, etc. He gives in detail the method of computing the amount of heat required to raise any liquid to a given temperature, and describes a method of heating not generally known which he claims is far more efficient than any other. The proper design and construction of both blast and atmospheric burners is discussed from an engineering standpoint in language that is practical and easy for the layman to understand, going back to the discovery of the Bunsen burner. The effects of improper design and construction are likewise given. The paper is illustrated by numerous lantern slides.

R. E. TALLEY, Ch. Engr., Geo. J. Hagan Co., Pittsburgh, Pa. Paper: *"Operating Data on Electric Furnaces."*

Abstract: The application of electric heating furnaces for scientific and experimental work during the past ten (10) years has been so general that their superior merits as a heating medium is well known to metallurgical men.

Due to the limited size of furnaces used for this class of work, however, the data obtained has been more in the nature of development of treatments rather than showing just what performance could be expected from larger units in commercial production.

It has only been within the past two (2) or three (3) years that applications of electric furnaces to heat treating on a production basis has become sufficiently widespread to permit of any real data as to their performance.

In the belief that data of this nature will prove of interest, the writer has chosen a number of the larger sized electric furnace installations, and has set forth rather complete information as to their operation. While the tests thus far are by no means complete, the results obtained have demonstrated that the overall cost of heating electrically compares favorably with other methods.

The element of quality has been more fully demonstrated by the operation of large furnaces, and at the same time other superior features have been brought to light, which in many cases have proven to be of equal or more importance from a commercial standpoint.

The data presented covers such items as labor charges, working conditions, maintenance of equipment, oxidation and distortion of product, cost of subsequent operations, and continuity of service.

A. E. WHITE, University of Michigan; and J. S. VANNICK, Bureau of Standards. Paper: *"Note on Occurrence of Oxides and Nitrides in Boiler Tube Steel."*

Abstract: 1. The presence of compounds of oxygen and nitrogen in specimens of boiler tubing which had been found to be comparatively brittle is thoroughly described. The possible sources of contamination of the metal by the gases and their compounds are cited. A microscopic examination showed that the gases had been absorbed by the liquid metal, in the refining processes. In view of the recent interest in the appearance of nitrogen compounds occurring in iron and steel, the types of structures are described in detail. Attention is drawn to the occurrence of nitrogen compounds of the "divorced" type and a special form of one of them is described in detail. From an examination of the course of cracks tributary to the fractured surface, the path of rupture is found to prefer a transcrystalline course. This course is independent of the oxide streaks or nitride plates thus suggesting that the crystals are inherently brittle, probable due to the presence of gas in solid solution.

2. The relation of the physico-chemical problem of the solution of gases in metals and the practical forms in which the

problem appears are briefly sketched. In view of the lack of a working relation between the chemistry of the gas-metal systems and the corresponding mechanical properties, the quantity of the gases or their compounds that may be allowed in a metal is not definitely known. It is concluded that the miscroscopically visible presence of compounds of the gases in the steel indicate the destruction of its normal properties.

F. H. HELRIGEL, Metallurgist, Motor Products Co., Detroit, Mich. Paper: *"The Heat Treament of Copper and Brass."*

Abstract: The heat treatment of copper and brass, like the training of a child, begins before it is born. There are certain elements introduced into the metals from the ores which no amount of commercial refining will eliminate and which almost entirely govern the quality and use to which the metals can be put.

Copper occurs as pure metal, and as sulphide or carbonate. It is first roasted and then reduced to metal, much as iron is reduced in the blast furnace and later converted to steel in the open hearth. Very few impurities are present in copper. Zinc occurs as sulphide and carbonate and is reduced by distillation. It is from zinc that most of the impurities of brass are obtained; bismuth, arsenic, cadmium, iron, lead and tin occurring most often.

Brass is manufactured by melting up copper in crucibles or furnaces, adding to it scrap brass and zinc and pouring, either into castings or into forms for further working. Every quality that a brass casting must possess is imparted to it by its chemical composition. It can not be heat treated. Brass that is to be used for sheets, strips, tubing, etc., is further rolled, annealed, pickled and the process repeated until reduced to size.

One might state as final and conclusive that there is no such thing as heat treatment of copper and brass, that it can only be annealed, and if the metals were pure and annealing conditions ideal that would be so. However, foreign elements in brass, intentional or otherwise, almost govern its treatment. Iron and lead are to brass what phosphorus and sulphur are to steel, as to machining qualities, hardness and tensile strength. Manganese plays much the same role in each. Brass annealed dead soft, containing tin or iron, has a much higher tensile strength and hardness than pure brass. Other factors governing the annealing are degree of hardness, due to cold working, time and temperature. While the annealing of brass is a simple straightforward proposition, it requires a sympathetic understanding of what ails the metal to treat it accordingly.

J. A. GANN, Metallurgist, Dow Chemical Co., Midland, Mich. Paper: *"Dowmetal and Its Application."*

Abstract: When the United States magnesium industry sprang into existence during the early part of the war, The Dow Chemical Company was one of the parties actively interested. Pure magnesium may have its physical properties materially altered by proper alloying, yielding a series of alloys commercially known as Dowmetal. Its extreme lightness, great strength and other properties peculiar to the metal suggested its use as a piston material. Of all the simpler alloys investigated, the magnesium-aluminum series proved to be the best for piston purposes and, inasmuch as they indicate the general range of adaptability of Dowmetal and at the same time present some very interesting heat treating phenomena, they will be considered more in detail.

The curves presented show the variation in physical properties of magnesium-aluminum alloys with increasing aluminum content. They clearly indicate that alloys of widely different properties are

readily obtained and that for many purposes, the best combinations of physical properties are obtained with six to twelve per cent aluminum. The reason for all this becomes apparent as soon as we study the microstructure of the metal.

Magnesium-aluminum alloys are susceptible to heat treatment, the relative effect on their physical properties depending on the per cent aluminum present. The accompanying microscopic changes again offer us an explanation for the increase in strength.

H. L. HESS, Metallurgist, 216 Wayne Ave., Lansdowne, Pa. Paper: *"Non-ferrous Forgings."*

Abstract: The historical development of copper and its alloys is briefly developed.

Modern methods of melting copper alloys are considered and some space is given to composition.

Attention is then given to one of the most recently developed fields in nonferrous metallurgy namely nonferrous forgings. The machinery used in the production of nonferrous forgings and the possibilities of the finished products are fully discussed.

S. L. HOYT & G. H. BIERMAN, Met. Engrs., National Lamp Works, Nela Park, Cleveland, Ohio. Paper: *"On the Theory of Hardening Steel."*

Abstract: Realizing the present unsettled state of opinion on the hardening phenomena of steel, the authors have gathered together considerable laboratory data in an attempt to crystallize some of these ideas.

The iron-carbon diagram is used as a basis of discussion and heating and cooling curves are taken up.

The work of Portevin and Garvin on "The Experimental Investigation of the Rate of Cooling on the Hardening of Carbon Steels" is used as a basis for the development of several new ideas on microconstituents.

The various modern theories of hardening are reviewed and a "Modified Solid Solution Theory" is proposed.

PROF. O. E. HARDER, Instr. Metallurgy, School of Mines, University of Minnesota. Paper: *"Discussion of the Hardening of Steel and Other Alloys."*

Abstract: Discussion of the Hardening of Steel and Other Alloys—The phenomena observed in the heating, cooling, and tempering of steel are discussed, and especial emphasis is placed upon the important part played by solution and precipitation. Similar processes in nonferrous alloys are also discussed. Some generalizations are made with reference to the heat treatment of alloys and to the future possibilities from researches along these lines.

DON. H. STACKS, Con. Met. Engr., 1558 Boulevard, West Hartford, Conn. Paper: *"The Development of the Grinding Sparks of Steel as a Means of Carbon Determination."*

Abstract: The quality of iron and steel to produce sparks under certain conditions is acknowledged as ancient history.

When a piece of iron or steel is pressed against a fast revolving grinding wheel, minute particles of metal are removed and thrown into space which are observed at lines of fire and which seem to become molten and finally disappear—in case of an almost carbonless iron—shaped like a steel needle with the point in the direction of flight and slightly tipped at the end on account of the rapid cooling effect of the atmosphere. In case the iron contains a small amount of carbon the needle like effect is broken up with

an explosion and little lines of fire dart out of what was originally the needle like body. As the carbon increases, these secondary lines of fire again explode causing further subdivisions and the action continues as the carbon increases, until all that can be observed is a mass of explosions.

When steels contain alloys, such as nickle, chromium, vanadium, manganese, etc., the lines of fire and the spark explosions are more or less interrupted with less line of fire and smaller as well as larger explosions.

When all conditions are standardized, and by the use of known standards and with the personal equation eliminated, the inspection of steel can be successfully carried out by placing the unknown composition along with the known upon a specially designed automatic machine which will throw out two lines of fire and spark explosions simultaneously in such a manner that the carbon content of the unknown will be plainly observed for any commercial specification of steel commercially accurate.

Figures 4, 5, 6 and 7, which represent over one hundred determinations of open-hearth furnace checks and factory control work show that the average spark carbon results are identical with the combustion carbon, with the individual determinations checking on the average within 0.025 plus or minus and with but two extremes of 0.04 and 0.05 per cent of carbon variation from the standard combustion results.

A CONTRIBUTION TO THE PROBLEM OF THE INFLUENCE OF MASS IN HEAT TREATMENT

By E. J. Janitzky

THAT the mass of a piece of steel which has been heat treated greatly influences the physical properties of the steel, is well known, but very little has been done to ascertain whether the law which the relation of the mass has to the physical properties can be determined mathematically. With this idea in mind the author has prepared the following paper, the object of which is to point out that such a law exists, and that it can be determined mathematically.

In the *Journal* of the American Steel Treaters Society, Volume I, No. 1, October, 1918, the author wrote an article under the heading, "Mathematic Discussion of the Influence of Mass on Heat Treating." In this discussion it was pointed out that for a given mass of steel, the physical properties obtained are functions of the surface of the metal quenched. There were computed three different curves, representing three bodies, spheres, rounds, and plates. In these curves the ordinates in each case represented surfaces per pound of steel and the abscissae diameters of the spheres, diameters of the rounds, and thicknesses of the plates respectively.

If the surfaces in square inches per pound of steel be called S, and the diameters or thicknesses in inches be called D, it was found that

$$S \times D = 7.062 \text{ for plates,}$$
$$S \times D = 14.125 \text{ for rounds,}$$
$$S \times D = 21.185 \text{ for spheres.}$$

It will be noted that the constants of each equation are in the ratio 1:2:3. It is obvious that the equation $S \times D = C$ represents a hyperbola in which the asymptotes are rectangular. This fact led to the assumption that the tensile and hardness properties decrease with increased sections, following a hyperbolic curve.

Not having any actual data at hand at that time, it was decided to search for some which would define somewhat closer than heretofore the mathematical relationships which exist in regard to this question. In October, 1920, the report of the British Engineering Standards Association was published and it was in this report, No. 75, that the writer found some very reliable data which afforded an excellent opportunity for this study.

The analysis of one of the steels tested in the British investigation was as follows: Carbon 0.45; manganese 0.78; sulphur 0.02; phosphorus 0.025; silicon 0.32; nickel 0.0; chromium 0.0; tungsten 0.0; and vanadium 0.0 per cent.

The following test results were obtained from bars of this steel rolled to 3¼, 2⅜, 1¼ and ⅞-inch diameter respectively, and machined to 3, 2⅛, 1⅛, and 11/16 inches diameter respectively. The tests were heat treated before machining to test piece dimensions. The figures given in Table I and used in this discussion are considered by the British Committee as representing the true physical properties of the steel after the specified heat treatment had been carried out.

A note here as to the reliability of the results of the British investigators is not out of place. In this work four investigators were concerned, one of

A paper presented at the Indianapolis convention. The author, E. J. Janitzky, is metallurgical engineer, Illinois Steel Co., South Chicago, Ill.

whom was the manufacturer of the steel; each checked his results in triplicate. The results of the investigators agree very closely on this steel and therefore are considered as representing within experimental error the true properties of metal of this analysis. It should be kept in mind that the results of these tests represent the physical qualities of the center portions of

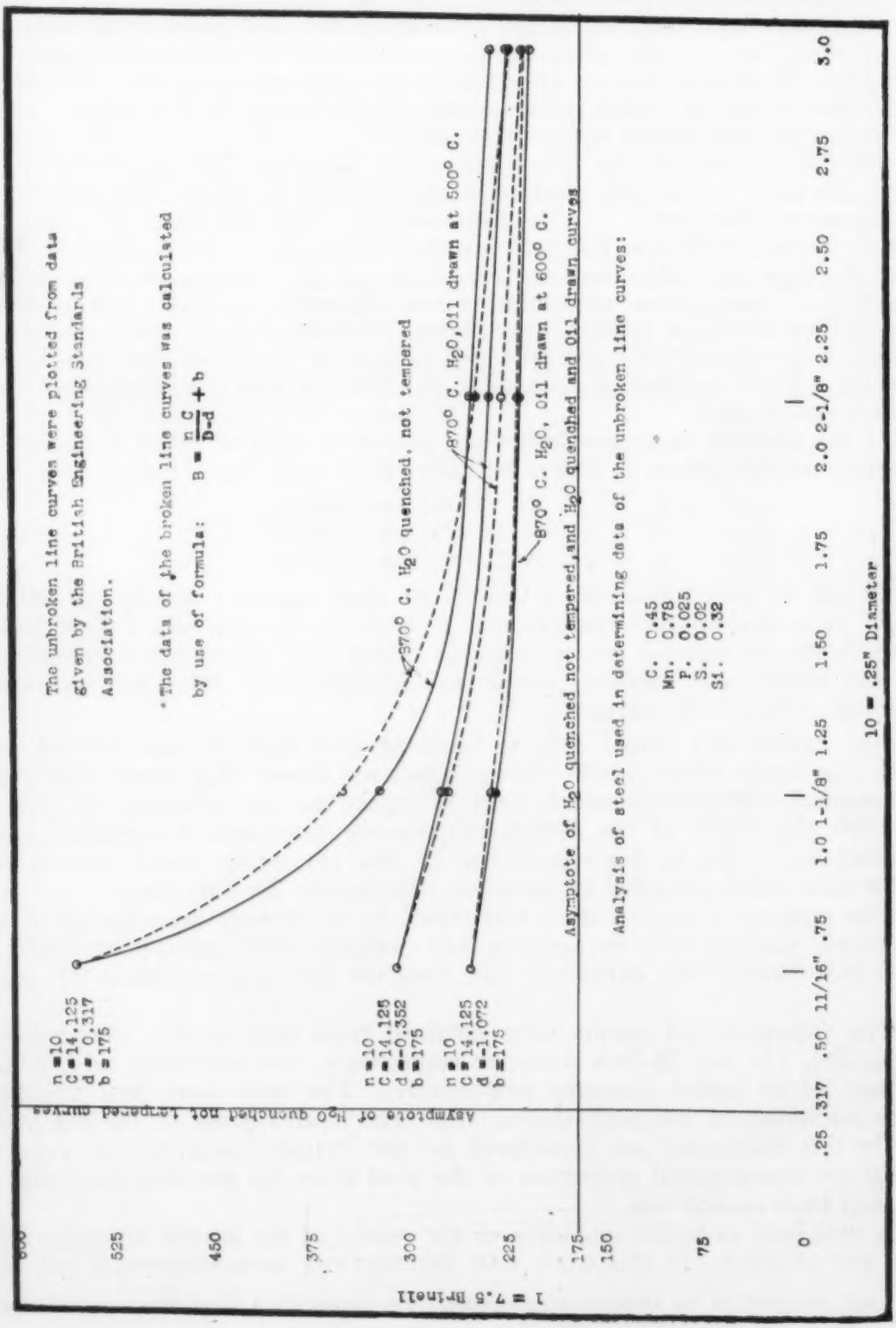
The unbroken line curves were plotted from data given by the British Engineering Standards Association.
The data of the broken line curves was calculated by use of formula: B = n C / D-d + b
870° C. H2O quenched, not tempered
870° C. H2O,011 drawn at 500° C.
870° C. H2O, 011 drawn at 600° C.
Asymptote of H2O quenched not tempered, and H2O quenched and 011 drawn curves
Analysis of steel used in determining data of the unbroken line curves:
C. 0.45
Mn. 0.78
P. 0.025
S. 0.02
Si. 0.32
n =10 C =14.125 d = 0.317 b =175
n =10 C =14.125 d =-0.352 b =175
n =10 C =14.125 d =-1.072 b =175
Asymptote of H2O quenched not tempered curves
1 = 7.5 Brinell
10 = .25" Diameter
.25 .317 .50 11/16" .75 1.0 1-1/8" 1.25 1.50 1.75 2.0 2-1/8" 2.25 2.50 2.75 3.0
0 75 150 175 225 300 375 450 525

FIG. 1—HARDNESS CURVES OF THE STEEL QUENCHED IN WATER AND NOT TEMPERED AND QUENCHED IN WATER AND TEMPERED

the rounds and thereby avoid any harmful effects which could be ascribed to the steep gradient of the hardness penetration which exists near the surface.

The rolled bars were cut to standard lengths for tensile and Izod tests, the length of the tensile test bar being 6 inches and that of the Izod 8¼ inches. In the case of the 1-inch and ⅞-inch round rolled bars, the tensile test pieces were cut 9 inches long, in order to afford a better grip for the testing machine; in cases where very great hardness was expected after heat treatment, the tensile pieces of the larger diameters were cut 10 inches long. After being cut, all the test bars were centered in an automatic centering machine in order to get the test pieces machined truly parallel with the cores of the test bars.

Table I

Tests On Bars of Varying Mass

Water Quenched from 870 Degrees Cent. and Not Tempered

Diameter of section treated inches	Maximum Stress pounds per square inch	Yield Point pounds per square inch	Elongation per cent	Reduction of area per cent	Izod impact	Brinell
11/16	269,000	258,000	3	4	3	555
1⅛	150,000	95,000	12	28	14	321
2⅛	125,000	83,000	18	43	16	255
3	116,000	76,000	23	54	24	241

Oil Quenched from 870 degrees Cent. and Not Tempered

Diameter of section treated inches	Maximum Stress pounds per square inch	Yield Point pounds per square inch	Elongation per cent	Reduction of area per cent	Izod impact	Brinell
11/16	130,000	96,000	18	50	22	255
1⅛	125,000	83,000	20	49	27	241
2⅛	116,000	76,000	23	54	24	228
3	110,000	72,000	23	55	26	217

Brinell impressions on the fractured tensile tests were made upon flat surfaces produced by milling down the shoulder on a screwed end of each specimen to the level of the cylindrical test portion. Only Brinell numbers of the tensile test pieces are given in this discussion, as they represent the actual hardnesses of the centers of the test pieces and are geometrically identical.

Using Brinell numbers as ordinates and diameters of the quenched sections as abscissae, two sets of curves were plotted from the British figures as shown in Figs. 1 and 2; in Fig. 1 are shown three curves representing respectively, the steel quenched in water and not tempered, the steel quenched in water and tempered at 500 degrees Cent., and the steel quenched in water and tempered at 600 degrees Cent.; likewise Fig. 2 shows curves of the steel treated as above except that the quenching was done in oil.

Consider the general formula, $S \times D = C$, that is, that the diameter of the section in inches multiplied by the surface in square inches per pound of steel for that section is constant. For rounds this formula is

$$(1) \quad S \times D = 14.125$$

The Brinell hardness of any section is in direct ratio to the surface per pound of steel according to the formula

$$(2) \quad B = n \times S, \text{ or } S = \frac{B}{n}$$

n being a factor which is constant for each steel of a particular analysis.

Substituting equation (2) in (1),

$$(3)\quad B \times D = 14.125\ n$$

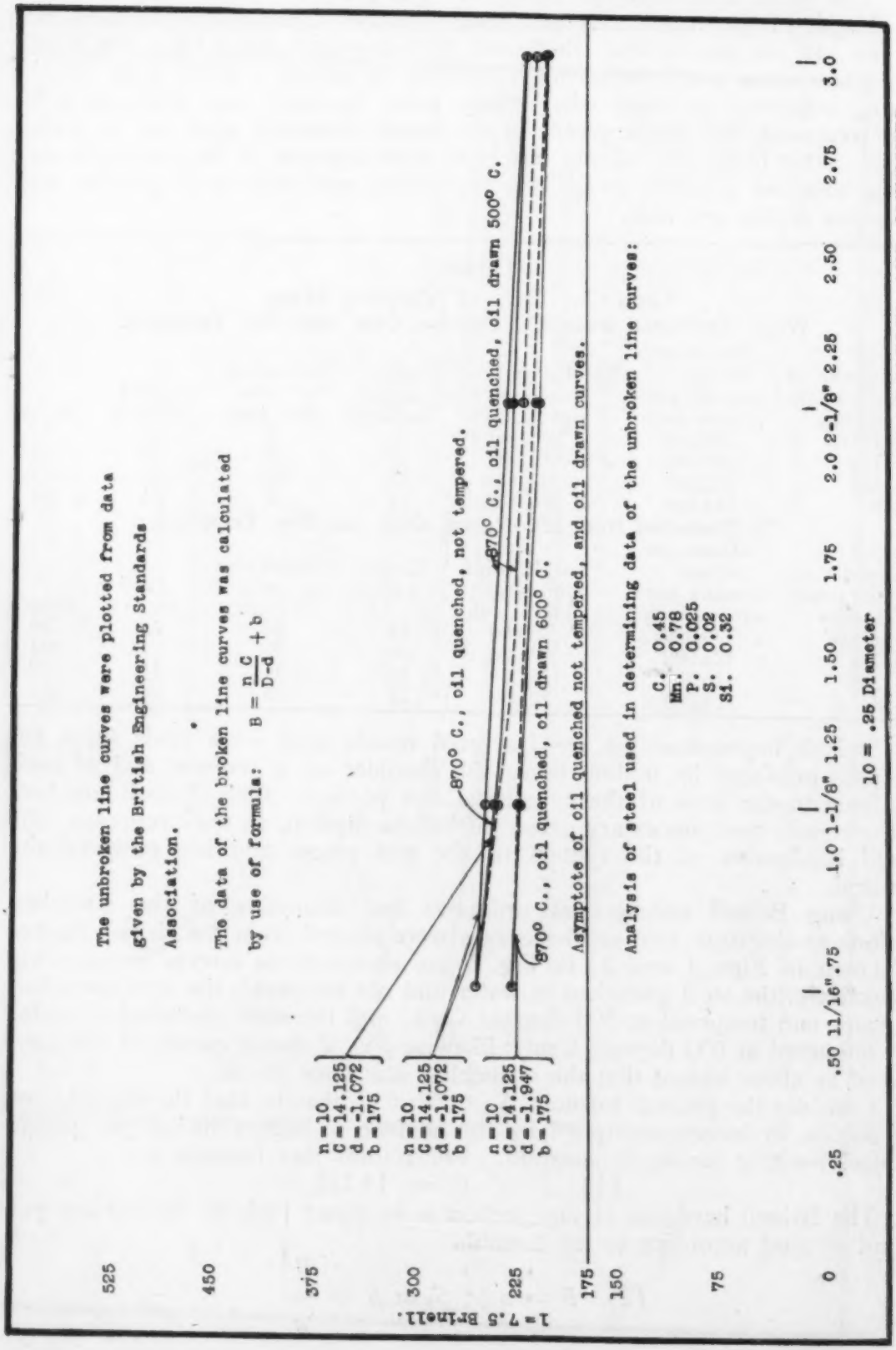

FIG. 2—HARDNESS CURVES OF THE STEEL QUENCHED IN OIL AND NOT TEMPERED AND QUENCHED IN OIL AND TEMPERED

This last equation is a true one, but in its present form is unsuitable for our purpose, inasmuch as it does not take into consideration the asymptotes of the curves. It can be seen that the axes of the rectangular system of co-ordinates are not the asymptotes of the curves. Equation (3) changed to take into account the asymptotes reads

$$(B - b) \times (D - d) = 14.125\ n$$

from which (4) $$B = \frac{14.125\ n}{(D - d)} + b$$

B is the Brinell hardness of any section desired.

n is a factor which is constant for each steel of a particular analysis; it appears to be the square of the hardening capacity.

D is the diameter in inches of a section the hardness of which is desired.

d corresponds to the vertical asymptote of the hyperbola. By solving the above equation (4) for d, an equation is obtained in which all the factors on the right-hand side are known or can be determined by experiment.

b represents the horizontal asymptote. For this steel it corresponds to a Brinell hardness of 175.

It has been stated that n appears to be the square of the hardening capacity for this steel. The hardening capacity of a steel is the ratio of the maximum hardness which can be developed in that steel to the hardness in the normally cooled state. In this case, the maximum hardness of this steel was taken to be that of an 11/16-inch section quenched in water, which gave a Brinell hardness of 555. Thus the ratio is 555/175 or 3.17. $(3.17)^2 = 10$. Therefore for 0.45 per cent carbon steel, $n = 10$.

Now again consider equation (4),

$$B = \frac{14.125\ n}{(D - d)} + b \qquad (5)\quad d = D - \frac{14.125\ n}{(B - b)}$$

With the discussion as it now stands, the following six curves are considered individually and their equations developed.

(1) 0.45 *per cent carbon steel quenched in water at 870 degrees Cent. and not tempered.* From the British experiment, an 11/16-inch round section of this steel quenched in water at 870 degrees Cent. and not tempered had a Brinell hardness of 555. Therefore, substituting in equation (5), using the value 555 for B, and 11/16 for D, there is obtained for d, the vertical asymptote, the value 0.317. Thus the formula for this curve is

$$B = \frac{(14.125) \times (10)}{(D - 0.317)} + 175$$

Using this formula to obtain the values for the Brinell hardness of other sections quenched in water at 870 degrees Cent., and not tempered, the following results are obtained:

Diameter of section quenched inches	Brinell Hardness from British Report	Brinell Hardness computed by formula
11/16	555	555
1⅛	321	350
2⅛	255	253
3	241	228

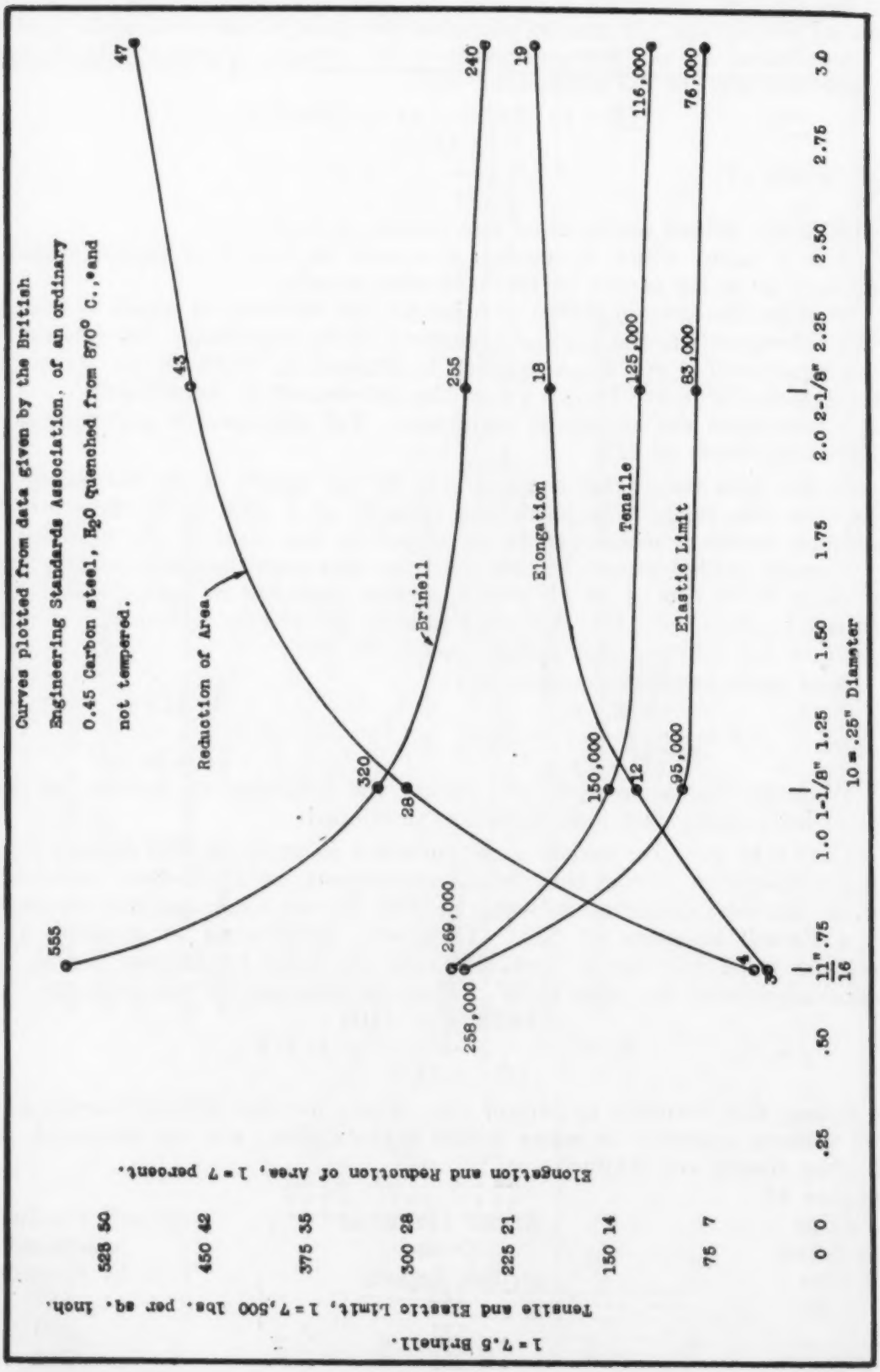

FIG. 3—CURVES COMPARING HARDNESS OF THE STEEL WITH OTHER PHYSICAL PROPERTIES

(2) 0.45 *per cent carbon steel quenched in water at* 870 *degrees Cent. and tempered at* 500 *degrees Cent.*

From the British experiment, B is 311 and D is 11/16. Substituting these values in equation (5), $d = -0.352$. Therefore, the formula for this steel quenched as indicated and drawn at 500 degrees Cent. is

$$B = \frac{(14.125) \times (10)}{D - (-0.352)} + 175.$$

The following results were obtained:

Diameter of section quenched inches	Brinell Hardness from British Report	Brinell Hardness computed by formula
11/16	311	311
1⅛	277	271
2⅛	241	232
3	229	217

(3) 0.45 *per cent carbon steel quenched in water at* 870 *degrees Cent. and tempered at* 600 *degrees Cent.*

From the British experiment, B is 255 and D is 11/16. Substituting in (5), $d = -1.072$. Therefore, the formula for this steel quenched as indicated and drawn at 600 degrees Cent. is

$$B = \frac{(14.125) \times (10)}{D - (-1.072)} + 175.$$

The following results were obtained:

Diameter of section quenched inches	Brinell Hardness from British Report	Brinell Hardness computed by formula
11/16	255	255
1⅛	235	239
2⅛	217	219
3	212	210

(4) 0.45 *per cent carbon steel quenched in oil at* 870 *degrees Cent. and not tempered.*

From the British experiment, B is 255 and D is 11/16. Substituting in (5), $d = -1.072$. Therefore, the formula for this steel quenched in oil as indicated and not tempered is

$$B = \frac{(14.125) \times (10)}{D - (-1.072)} + 175.$$

The following results were obtained:

Diameter of section quenched inches	Brinell Hardness from British Report	Brinell Hardness computed by formula
11/16	255	255
1⅛	241	239
2⅛	228	219
3	217	210

(5) 0.45 *per cent carbon steel quenched in oil at* 870 *degrees Cent. and tempered at* 500 *degrees Cent.*

From the British figures, B is 255 and D is 11/16. Substituting in equation (5), $d = -1.072$. The formula for this steel quenched in oil as indicated and drawn at 500 degrees Cent. is

$$B = \frac{(14.125) \times (10)}{D - (-1.072)} + 175.$$

The following results were obtained:

Diameter of section quenched inches	Brinell Hardness from British Report	Brinell Hardness computed by formula
11/16	255	255
1⅛	248	239
2⅛	228	219
3	217	210

(6) 0.45 *per cent carbon steel quenched in oil at* 870 *degrees Cent. and drawn at* 600 *degrees Cent.*

From the British figures, B is 229 and D is 11/16. Substituting in (5), $d = -1.947$. The formula for this steel is

$$B = \frac{(14.125) \times (10)}{D - (-1.947)} + 175.$$

The following results were obtained:

Diameter of section quenched inches	Brinell Hardness from British Report	Brinell Hardness computed by formula
11/16	229	229
1⅛	223	221
2⅛	207	210
3	202	204

From the foregoing calculations it is apparent that the factors which control d in any carbon steel are the drasticity of the quenching medium and the extent of the tempering operation. As the drasticity of the quench becomes less and as the degree of the tempering becomes greater, the vertical asymptote d moves towards the left into the second quadrant of the system of co-ordinates.

It is interesting to compare the Brinell curve with the curves of other physical properties, such as, tensile strength, elastic limit, elongation and reduction of area. This has been done Fig. 3 shows a similar hyperbolic tendency of these curves. The Brinell and tensile curves run parallel as is to be expected.

The figures given in this paper speak for themselves, and point to the possibility of mathematically predicting results which are to be expected in different sizes of heat treated steel.

EFFICIENCY OF VARIOUS QUENCHING MEDIUMS WITH THEIR PRACTICE AND APPLICATIONS

By James B. Morey

PROPER handling of quenching mediums is one of the most important factors in the successful hardening and tempering of steels. Much has been published concerning various processes of hardening and tempering as well as the furnaces used, but very little has been written regarding the baths or mediums used. In the past, the hardener carefully guarded his own secret composition of quenching baths, however, that time has gone. It is now realized that the mediums must be thoroughly understood and properly handled to bring the desired results of economy and efficiency in the present day production of treated tools.

A first and fundamental consideration is that hardening consists of but two operations of change in temperature; heating and cooling. The object of heating is first, to obtain refinement of structure; and second, to secure the formation of so-called hard constituents in the steel. With this object accomplished, the steel is held in this condition by more or less rapid cooling, depending upon the specifications desired. Water, oil, and air are the most common mediums for such cooling, but many others which are used more or less commercially will be discussed as well.

Regardless of the composition of a quenching bath, the temperature of the bath must be kept uniform at all times in order that dependable results shall be obtained. This is necessary so that successive pieces or tools will undergo the same changes and the results will be the same. Too much emphasis cannot be placed upon this provision, for without a uniform temperature of bath it is impossible to forecast what results will be obtained. Quenching baths of different compositions produce various hardening results due, of course, to the heat dissipating power of the different baths. This property of withdrawal of heat from the steel depends upon the specific heat of the medium, its viscosity, conductivity, and volatility thus by obtaining a proper combination of these various properties, a bath giving the desired results can be secured.

Steel quenched in brine will be much harder than if quenched in water from the same temperature, since the brine dissipates heat more quickly. Oils are slower in their quenching powers than either water or brine, but have a much more uniform rate of cooling at higher temperatures than the latter. Clear cold water is employed commonly for steels of low carbon content, as well as for simple sections of higher carbon steels without danger of fraction due to the internal strains caused by the more drastic action of the water. It is imperative that water or a brine medium be used where the surface must be glass hard. If the steel is required to have a full heat treatment, that is, quenching and toughening, it is possible to secure about the same hardness by either water or oil quenching, providing a lower drawing temperature is used for the oil quenched piece. The objection to oil quenching and a lower drawing temperature is that this temperature is not so easily discerned by its color. In general, however, oil quenching is more desirable than water quenching, since water cools so rapidly that cracking becomes a

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A paper presented by title at the Philadelphia Convention. The author, James B. Morey, is foreman wire mill annealing department, Atlas Crucible Steel Co., Dunkirk, N .Y.

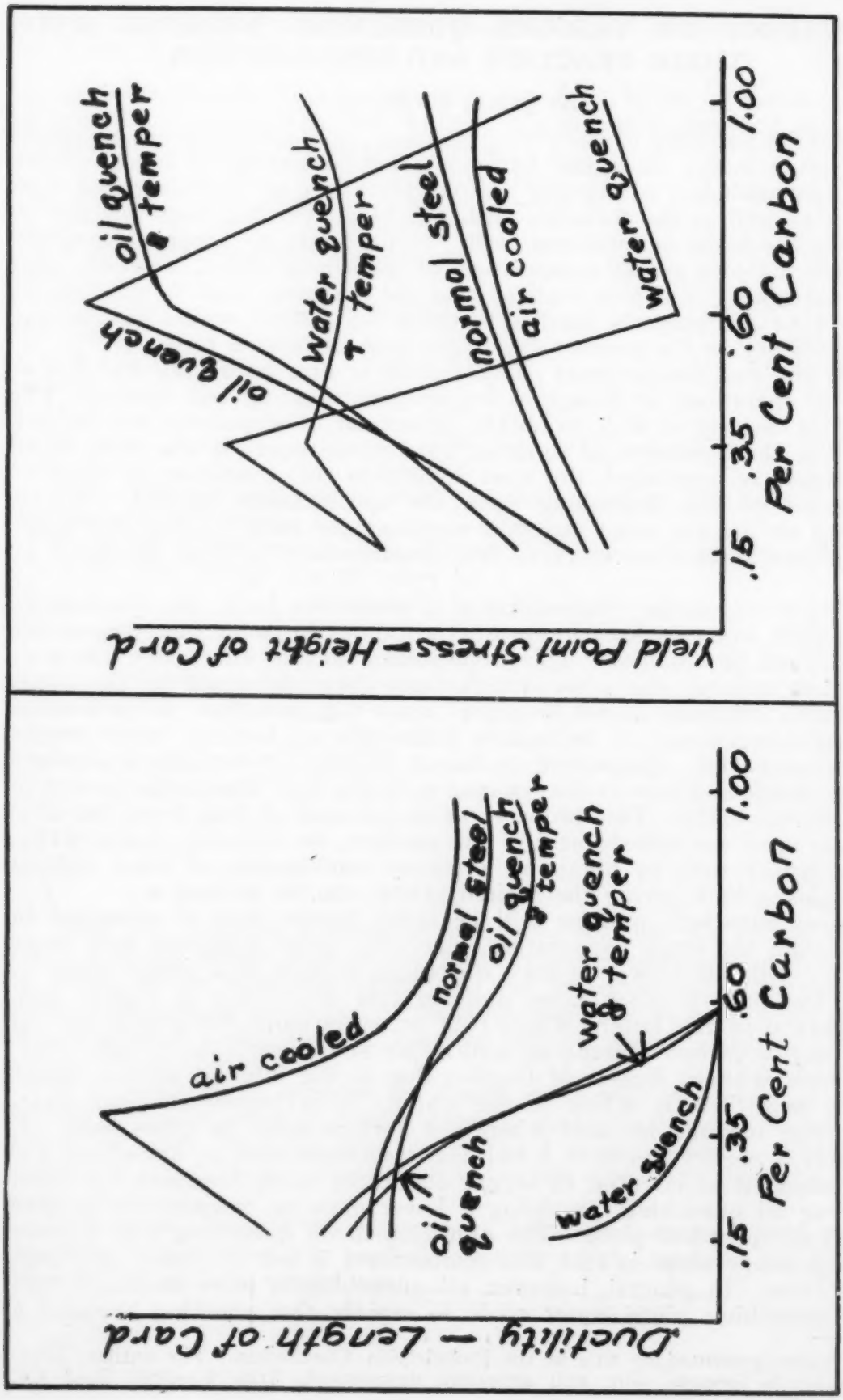

FIG. 1—DUCTILITY OF CARBON STEELS UNDER DIFFERENT HEAT TREATMENTS. FIG. 2—YIELD POINT STRESS OF CARBON STEELS UNDER DIFFERENT HEAT TREATMENTS

serious consideration. If water is to be used care must be taken in its selection, as greasy substances in water sometimes interfere to the extent that the steel cannot be hardened; or if certain acids are present, the steel may become brittle or may even crack.

Sperm and lard oil baths are much used for hardening springs, while raw linseed oil is a good medium for small tools, such as cutters. Brine is little used save for such pieces as require an extremely high degree of hardness, such as files. In this case, it must be certain that the file is of the proper chemical makeup, otherwise cracking is sure to result. Large sections cannot be quenched easily in brine because of the rapid surface cooling while the center remains hot, therefore severe strains are set up and are not relieved during quenching. Cracking is the result. A method of quenching used somewhat on pieces requiring differential hardening, such as die blocks, anvil faces, edge tools, as well as armor plate, consists in spraying the pieces with water under high pressure. This method gives a more rapid cooling than either brine or water baths, but the spray must be of sufficient volume to prevent the formation of steam between the spray and the hot steel.

While discussing oil and water hardening, mention should be made of one or two methods by which tools may be cleaned or brightened at the same time as quenched. A small amount of salammoniac in an oil bath will cause the piece to brighten up; and a solution of 3 per cent sulphuric acid with 97 per cent water will do very well to clean hardened carbon tools. Reamers, drills, and tools of this nature are handled in this manner to obviate the necessity of polishing the flutes after quenching.

Certain special means of applying quenching agents are called into practice on occasion. In the case of large forgings where high tensile strengths are required, it is often considered poor practice to immerse them directly in cold water, thus a bath of oil and water is used, the oil, of course, floating on top and being of the same volume as the water or perhaps a little less. After heating the forgings to the hardening point they are dropped into the oil and then down into the water. In this manner the oil forms a film on the piece which retards the direct cooling action of the water. The time for cooling may be varied as desired by changing the length of time that the piece is held in the oil. In the case of small thin steel tools, this method is used occasionally, with only a thin film of oil on the water. However, this method of oil or water should not be used unless the operator doing the work is thoroughly experienced as cracking occurs easily.

Sea or salt water is the keenest natural water. Water containing soap is sometimes used to form a protective coating around the piece. Sweet milk, mercury and carbonate of lime, wax and tallow are used occasionally for special purposes. Calcium chloride is often added to water, which medium can be used to 175 degrees Fahr. and gives many of the advantages of an oil bath. Air is the common agent used for the hardening of high speed steels, although an oil bath is also employed to a large extent. When air is used, it must be in the form of a blast for mere exposure is usually insufficient to produce hardness.

Regarding the size of tanks for quenching baths, it may be said that they should be of sufficient size to handle the maximum size of stock to be treated, and the number of pieces when operating at capacity should be a consideration. Furthermore, the size should be determined

FIG. 1—DUCTILITY OF CARBON STEELS UNDER DIFFERENT HEAT TREATMENTS

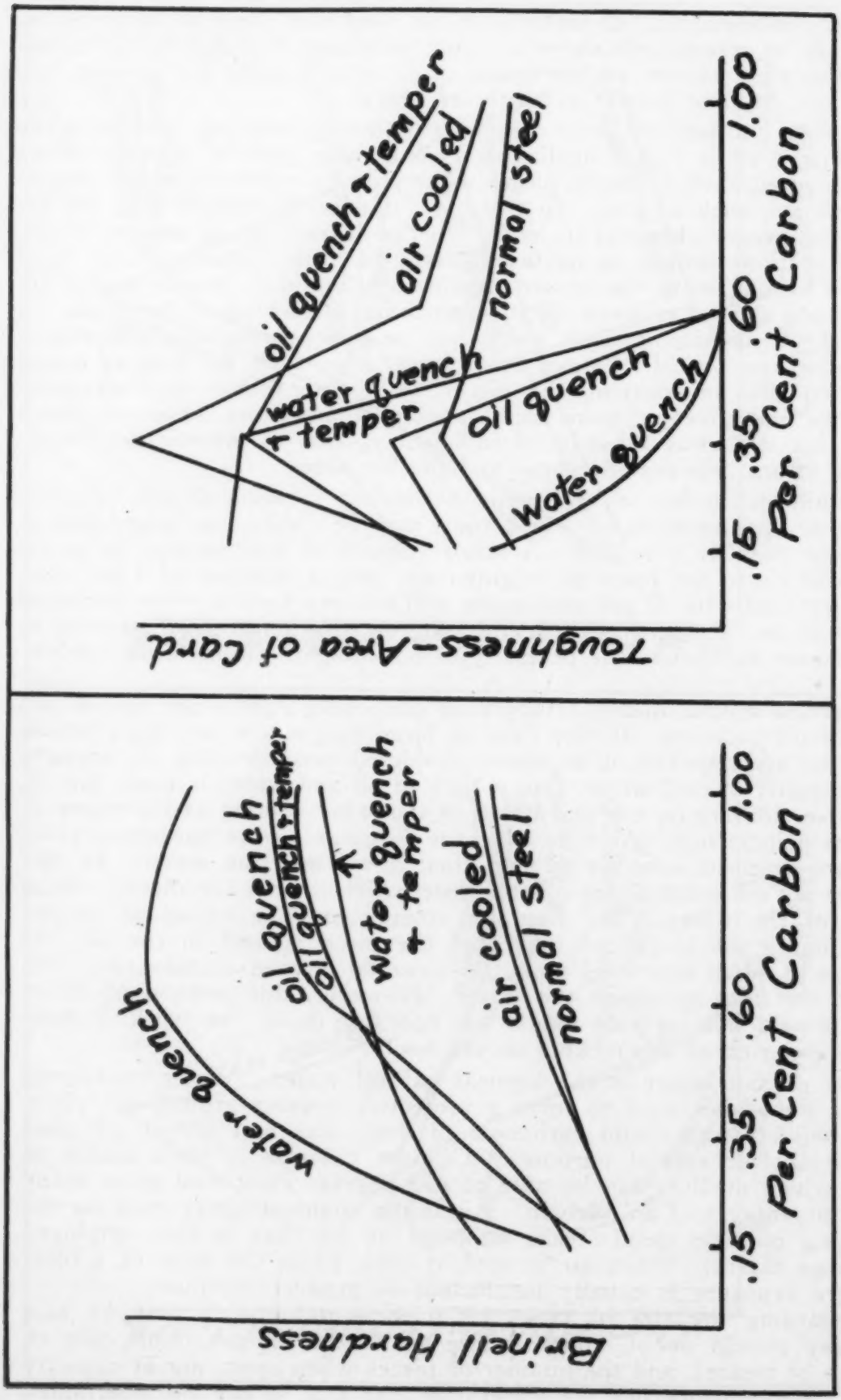

FIG. 3—BRINELL HARDNESS OF CARBON STEELS UNDER DIFFERENT HEAT TREATMENTS. FIG. 4—TOUGHNESS OF CARBON STEELS UNDER DIFFERENT HEAT TREATMENTS

somewhat by the cooling system employed; since the more efficient this is, the smaller the tank need be to operate properly. As mentioned before, the bath should be of uniform temperature at all times, thus it is necessary to provide for the bath being agitated in order that an even distribution of temperature is assured. When the bath is well agitated, the piece being hardened need not be kept in motion. This may seem a minor point, but experience has shown that it is important, especially in the case of long pieces which are more apt to come out straight after hardening.

Best results in quenching are obtained generally when the pieces are immersed vertically in the direction of their greatest dimension, but this rule is not hard and fast. Half-round pieces, plates, axles, etc., require other methods. Irregular shaped tools should enter the bath with their heaviest section foremost. The piece should never be dropped to the bottom of the tank until quite cool. Where one must depend upon unskilled operators, the rule of quenching vertically can be successfully applied in the case of symmetrical sections. To explain why it is best to immerse the piece vertically downward rather than at an angle, let us take the case of a long, narrow round bar. The general tendency is to remove the bar from the furnace with the tongs at the end rather than at the middle, and in the haste to get it into the bath, the average worker will plunge it in at an angle. Thus one end strikes the solution before the rest, and initial hardening strains result which usually cause a bent bar. It is proper to grasp the bar at the end, but care should be taken that it is held vertically as it is plunged into the quenching bath. Especially in the case of hollow forgings such as guns, vertical quenching is essential to prevent the pocketing of any steam that may be formed.

Although much study should be given the proper quenching baths for hardening purposes, it is not nearly so important in the case of tempering baths for the drawing of steel pieces. The object of tempering is merely to reduce brittleness and relieve strains caused by quenching. Oil is widely used where quantity production must be considered. Besides oil, there are sand baths, hot air tempering and tempering in lead, the latter baths being used when the tempering heat must be higher than the flash points of the common oils. The objection to lead baths is that the temperature in all parts of the bath is not the same due to the lead not circulating readily. Initial cost, effects on the finish of tools, and lasting qualities should be the outstanding factors in the selection of tempering baths.

While doing some research work, the author once performed a test to study the properties of several heat treated steels of various carbon contents. It was also desired to make a comparison of their properties after cooling by different mediums; particularly as regards hardness and toughness. The carbon contents of the four steels tested were 0.15, 0.35, 0.60 and 1.00 per cent, respectively. Each steel was given five heat treatments and tested; also a normal steel of corresponding carbon content was tested in order to make a fair comparison with the treated steels. The treatments were as follows: The steels were heated to a high temperature and then air cooled, water quenched, oil quenched, water quenched and tempered, and oil quenched and tempered. The quenching temperature for the 0.15 and 0.35 per cent carbon steels was 895 degrees Cent., and the tempering temperature, 360 degrees Cent. For the 0.60 and the 1.00 per cent carbon steels, the quenching temper-

ature was 800 degrees Cent., while the tempering temperature was 310 degrees Cent.

The test pieces, having received the above treatments, were tested for Brinell hardness, ductility, yield point stress and toughness. The manner of obtaining relative data for the latter three properties was as follows: A piece of steel was placed in the jaws of a testing machine and clamped; motion was transmitted to these jaws by which the piece was bent back and forth, and as the motion progressed a stilus fastened to a reciprocating arm moved up and down on a card, giving a fair representation of the action of the test piece. Thus the length of the card was a measure of the ductility of the piece; the height, a measure of its yield point stress; and the area in hundredths of a square inch showed its relative toughness. The Brinell hardness was determined for each piece by means of the usual method. The accompanying four curves, Figs. 1 to 4, plotted with carbon contents as abscissae and ductility, yield point stress, Brinell hardness and toughness, respectively as ordinates, show the results of these tests.

It seemed that the ductility of the normal steels fell off slowly with an increase in carbon content. The reason for this was assigned to the structure which the carbon caused in the steel and the form in which it was present. In normal steels no carbon is present as an iron carbide, or cementite, a hard, brittle and hence nonductile substance. Thus an increase in carbon in such steels means an increase of cementite and a subsequent decrease in the ductility. As for the pieces that were treated and air cooled, the ductility seemed to be highest for the 0.35 per cent steels and then fell rapidly with an increase in carbon content. The effect of the slow process of air cooling, of course, is the relieving of the stresses caused by previous working of the metal. It would seem that air cooling in these tests was best only in the case of the 0.35 per cent carbon steel, as regards ductility. The water quenched steels lost all ductility above 0.60 per cent carbon. It is probable that this loss of ductility was due more to the rapid cooling than to the increase in carbon content; for it left the steel much in the martensitic stage, martensite being a solid solution of iron carbide in iron, very close grained but brittle and lacking ductility entirely. Oil quenching was not nearly so rapid as with water, as is seen. Here again, however, it is likely that considerable martensite is present after quenching, although the result is not as pronounced as in the case of the water quenched pieces. Also it was noted that when the pieces were oil quenched and then tempered, the ductility for all carbon contents was much improved. This tempering resulted in carrying the piece further toward the sorbitic or softer stage and left little of the martensite, the condition in which the steel would have been had not the piece been tempered. From these results it is concluded that if we had several steels of different tempers or carbon contents and desired but little change in ductility, say from 0.60 to over 1.00 per cent carbon, this treatment of oil quenching and tempering would be preferred.

It was found that in a normal steel the yield point stress increased with the carbon content. This is easily explained by the fact that with increased tempers the iron carbide or cementite present increased; and this substance is decidedly strong, especially in shear. In the water quenched pieces, the higher carbon steels showed a great drop in yield strength, due to the effect of too great cooling strains in this rapid method

of quenching. The oil quenching and tempering seemed to be the best treatment for increasing the yield strength. Tempering relieves cooling strains but leaves some of the steel in the martensitic field or harder condition, while some has changed in some degree into the troostitic or even the sorbitic condition or the softer stages. Hence tempering is a softening process as well as one that increases toughness. The oil quenching and tempering is a good treatment for high carbon steels, as it increases their toughness and relieves their brittleness to some extent.

The determining factor of hardness as a property of steels, is the amount of martensite present. Thus if hardness alone is considered without reference to either ductility or toughness—we would water quench the steel, as this treatment leaves the metal almost entirely in the martensitic field. But this is deleterious to the strength of the piece and may even crack it, so as before, an oil quench and temper treatment is recommended especially for the higher carbon contents. In water quenching and tempering, the tempering caused a decrease in hardness. This treatment is often applied to brittle steels.

In conclusion, an example of heat treatment for a carbon steel is given. In the manufacture of skates, a tough steel that is also hard enough to hold a good edge, is required for the edge or blade. A 0.60 per cent carbon steel, oil quenched and tempered would serve very well for this purpose. Now for the upper part of the skate a tough, strong but not a hard steel is desired. A 0.35 per cent steel, oil quenched and tempered would turn the trick, since it could be shaped and drilled, and is also tough and lasting. A simple process of welding the top to the bottom piece produces a good skate. In the making of carbon tool steels, the carbon range is from 0.80 to 1.00 per cent, and the best practical treatment is one consisting of oil quenching and tempering since this gives hardness and required toughness, with some ductility and good strength.

INVESTIGATION OF FATIGUE OF METALS UNDER STRESS

By H. F. Moore

AT PRESENT, the author is connected with an investigation of the so-called fatigue of metals under stress. So far the more fundamental and simple case of the repeated stress has been studied, without the additional complexity of impact which might bring in other factors. It is felt that this investigation, which has been in active progress for a little over a year, has shown more conclusively than has been shown before that steel under repeated applications of stress, reversed from positive to negative, will not fail below some fairly clearly defined limiting stress that does not bear any definite relation to the ordinary elastic limit in some cases and about one-half the elastic limit in others.

I might be asked, first, what is fatigue. The old view is summed up in the word "crystallization." The idea was that under repeated stress the material changed its crystalline structure. I do not know of any evidence in favor of the theory that metals materially change their crystalline structure under repeated stress. The crystals are broken under repeated stress. The second theory, advanced by Bauschinger, the German scientist, is that under repeated stress some inherent property of the material changes its elastic limit; it is an inherent property of the material, possibly some property of the amorphous cement between the crystals. The third view is that all fatigue of metals is the result of the spread of damage from little localized overstresses.

I do not feel justified in stating my positive belief in the third view as against the second, but I have yet to run across a case of failure of steel or other metal, either in the laboratory or in service, that could not be explained by the gradual spread of damage from some nucleus.

It was found, for example, that it is possible to subject a homogeneous steel, such as a 0.90 per cent carbon steel, that has been thoroughly annealed, to one hundred million reversals of stress as high as the elastic limit of the steel with no sign of failure. The test was stopped at one hundred million because the machines were required for other work. Forty-five days, continuous running at 1500 revolutions a minute is required to produce one hundred million repetitions. On the other hand, a complex structured steel like a chrome-nickel steel that has been hardened with very little drawing, will fail at a stress about 58 per cent of its elastic limit. Between these two are obtained a variety of results.

In the steel work of any building, there are undoubtedly many thousands of places where structural damage was done—where riveted members were bent into place cold and where the rivets were fitted with drift pins, and things of that kind. Locally the steel in the building was stressed beyond its yield point in many places. These little localized overstresses do no damage at all; the building is entirely safe. But if this building were subjected eight or ten times a day to a mild earthquake, these little localized overstresses might be nuclei from which damage would spread and eventually we would have trouble. That is, these little localized overstresses may not be important if the structure is loaded a few times, but they may be of importance if the structure is loaded many thousands of times.

The existence of localized stress has been demonstrated by direct ex-

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A paper presented before the New York meeting of the American Institute of Mining and Metallurgical Engineers, February, 1921. The author, H. F. Moore, is professor of engineering materials, University of Illinois, Champaign, Ill.

perimentation with delicate extensometers by the elaborate investigations of the British scientist, Coker. Localized stresses four, five and six times those that we would get by the ordinary laws of mechanics exist in most of our structures. These stresses, ordinarily, under steady load do no damage but if they are repeated many times may start progressive failure.

So far no failure has been found that could not be explained by localized high stress, at a niche, a crack, at a point where one heat treatment stopped and another began, or where there was local faulting due to that fact, possibly due to a place where there was local blue brittleness—or any one of a dozen causes. Certainly in the case of drill rods the actual distribution of stress must be different from that which any mathematical analysis could predict. It would seem that the spread of damage from the localized overstresses, so far as we can see now, explains the phenomenon known as fatigue.

HEAT TREATMENT NOT ALWAYS THE CAUSE OF FAILURE

By Charles A. Brooks

IN ONE particular pneumatic rivet die which came to the attention of the author recently, four defects were discovered. The end which the piston plunger struck was not sufficiently crowned, the fillet at the shoulder was entirely too small, machine tool lines were in evidence at this point, and there were sharp shoulders where the spring retainers gripped. These defects were a result of faulty design or ignorance, yet when the set proved inefficient, the difficulty was assigned to an improper temper by the man who used it. But the steel treater was not at fault. In another case of intricately shaped car molding dies, failure was also given as an improper temper. Here the true trouble was a slight difference in the oversize thickness of metal rolled, insufficient space between the male and female die, as well as the failure to reheat the metal after the oxyacetylene weld before continuing the operation. Second heatings at a slow gradual cooling down would have relieved the hard state of the metal. In fact, the metal was as hard after the weld as was the small raised sharp edged ring shaped part of the third step finishing dies. Most steel treaters appreciate the hard condition of 1-16 to ⅛-inch steel plate after oxacetylene welding. Until careful attention was given to a second heating with slow cooling down, difficulty was experienced. This with a closer inspection of gage size of stock to be rolled overcame all trouble with roll die failures.

Punches operating on ship plate up to 1-inch thick gave good service but when extra heavy plate 1⅛ to 1½-inch thick was placed under the punch, trouble arose. This was assigned to faulty heat treating, but examination showed that the greater part of the breakage occurred at a point close to the sharp shoulder where the machine chuck gripped the punch. The punches were annealed and returned to the machine shop to be turned back ⅛-inch, leaving a fillet where the sharp shoulder was before. After this change and the identical heat treatment as before, the punches stood up well on the heavier plate. This proved that the original heat treatment was not in error. In a similar instance of a tool for bellying out large boiler tubes before beading them, design was at fault. This tool, which was of the pneumatic type, was of a cut off cone shape with the bellying end considerably out of proportion to the plunger part that fit into the riveting machine. Each die had a short life and several kegs of broken ones had accumulated. A new shape of tool was suggested and although apparently of an impractical nature, six of them were forged. After months of service, the same six are still being used. A record was kept up to 20,000 tubes processed on one die, this being a sufficient number to prove that the new type was practical and efficient. Faulty design, rather than improper heat treatment was the cause of failure in the first dies.

Changes in design of an offset die used for bucking up rivets also proved beneficial to a previously unsatisfactory tool. The changes consisted of generous fillets and providing a longer taper between the heavy and light body parts of the tool, as well as holding the body end of the tool to as small a diameter as possible to overcome difference in weight resistance.

A paper presented before the Philadelphia Chapter. The author, Charles A. Brooks, is foreman steel treater, Bethlehem Shipbuilding Corp., Ltd., Wilmington, Del.

These modifications overcame practically all trouble and discredited the theory of improper heat treatment. Making the reacting hammer pistons from 16.5 per cent tungsten steel instead of high carbon steel overcame wear and breakage on this type of tool. A more recent change of using a slightly shorter piston of the same weight of the longer carbon steel piston has resulted in a faster stroke and rivets driven quicker. Sticking in the chamber of the machine, such as often occurs with carbon tool steel however tempered or crowned, has been eliminated entirely.

A general rule of the average steel treater seems to be the giving of extreme hardness consistent with no breakage. It is also a common belief that the frequent grinding necessitated in high speed steel is an indication that the tools are too soft. This is not always true. With a high speed tungsten steel, the hardest point possible for production may be obtained together with the necessary hardness, but the cutting edge may not have a satisfactory edge retaining property, thereby requiring frequent grinding. A good tool must not have this latter property. A high speed steel containing 16 or 17 per cent tungsten in its hardest state shows edge crumbling but a lower hardening heat with oil quenching ending at flash and a slow cooling will produce a tool, which although considerably softer, will require less grinding and give longer service. The author recalls one steel salesman, who in demonstrating a good high speed steel, lost the sale because he did not understand the practibility of obtaining a lasting cutting edge along with the highest degree of hardness. Of course, there are various causes for tool failure such as grinding too great a clearance, pressing too hard on a dry wheel and then dipping into water, and taking too heavy a cut in the machine. More care must be used as to the service required from the tool; pneumatic vibration, rigid holding for machine service or punch or shear service. The tools must be designed suited for each service. This is just as essential as the steel used and treatment given. The heat treater, toolroom foreman and superintendent must co-operate closely to this end. Many failures will be offset by making a study of the tool or machine part prior to making the design. Tools may be forged or machined easily but they will not always do the work expected. In following old standards, we are too prone to neglect possible causes of failure other than heat treatment.

Too many failures are laid at the door of the steel treater. Thus it is essential that he state explicitly his views when he knows failures are not the result of heat treatment. For the advancement of science his views must be considered. It is impossible to make tools or machines stand up in service when the mechanical design is in error. To arrive at the source of trouble where tools and machines are manufactured and to produce work of good quality, careful analysis, good judgment and co-operation are absolutely essential.

OBITUARY

H P. MACDONALD, vice president of Snead & Co., Jersey City, N. J., and a member of the American Society for Steel Treating died at his summer home in New London, Conn., on Aug. 25. Mr. Macdonald was born in Louisville, Ky., on May 19, 1880 but during recent years has made his home in Montclair, N. J. He graduated from the Massachusetts Institute of Technology in 1901 in civil engineering. He entered the employ of Snead & Co., the same year and served successfully as assistant superintendent, general superintendent, chief engineer and vice president. He was a member of the Society of Automotive Engineers, American Society of Civil Engineers, and American Society of Mechanical Engineers.

Among Mr. Macdonald's achievements are a number of inventions including a series relative to the electrical heat treating of ferrous and non-ferrous metals by means of internal resistance. This system was used extensively during the war for the heat treating of steel tubing required for airplane plants of Italy, England and the United States. He also made a series of inventions useful in the automotive industry relating to propeller shafts having flexible fabric joints and the preheating of gasoline by means of electric current.

Members of the Society will be shocked to learn of the death of Mr. Macdonald. It will be recalled that he presented a paper at the Philadelphia Convention describing his electric method of heat treatment of shafting and tubing, the paper later being published in TRANSACTIONS. Mr. Macdonald's illness started in 1917. He was operated on for cancer in 1918 after which he made a partial recovery. He was again operated upon in 1921 but his death followed a few months later.

NEW MEMBERS' ADDRESSES OF THE AMERICAN SOCIETY FOR STEEL TREATING

EXPLANATION OF ABBREVIATIONS. M represents Member; A represents Associate Member; S represents Sustaining Member; J. represents Junior Member, and Sb represents Subscribing Member. The figure following the letter shows the month in which the membership became effective.

CARROLL, Frank L., (A-10), Steel Sales Corp., Chicago, Ill.
CLAYTON, Charles Y., (M-10), Box 248, Rolla, Mo.
GLADHILL, H. E., (M-9), 715 East Ann St., Ann Arbor, Mich.
HOWE. A. C., (M-9), American Locomotive Co., Paterson, N. J.
HUGHES, A. F., (M-9), 1522 East 62nd St., Chicago, Ill.
JONES, D. J., (A-10), 3319 Park Ave., Indianapolis, Ind.
KELLER, M. S., (M-10), 114 S. Wisner St., Jackson, Mich.
LAWRENCE, George L., (A-10), 7709 S. Morgan St., Chicago, Ill.
LUEBKE, Otto, (M-10), 519 Clinton St., Grand Haven, Mich.
MONK, Grant, (M-8), 1177-208 S. LaSalle St., Chicago, Ill.
NIXON, I. L., (M-9), Bausch & Lomb Optical Co., Rochester, N. Y.
PATTERSON, W. L., (S-9), Bausch & Lomb Optical Co., Rochester, N. Y.
RICHTER, C. P., (M-10), 309 W. Main St., Massillon, O.
RUSHMER, H. W., (M-10), Westerville, O.
SCOTT, F. L., (M-10), Hughes Tool Co., Houston, Tex.
SHULTZ, L. E., (A-9), 338 West 4th St., Cincinnati, O.
STACK, Edward, (M-6), 6335 Walnut St., Pittsburgh, Pa.
WHITE, H. A., (M-9), Sparks Withington Co., Jackson, Mich.

CHANGES OF ADDRESS

ALLISON, F. G.—from 162 Meredith Ave. to 500 Clinton St., Milwaukee, Wis.
BARTLETT, L. D.—from Nicholson File Co., Providence, R. I. to 4 Washington St., Warren, R. I
BEEARS, Byron—from 401 N. 10th St.—to 925 Robeson St., Reading, Pa.
BOISSONEAU, A. F.—from 6724 Normal Blvd. to 1001 W. Washington St, Chicago, Ill.
BRESSLER, W. J.—from 7042 Torresdale Ave. to 3032 Tyson St., Philadelphia, Pa.
BRODMERKEL, G. H.—from Rio De Janeiro, S. A. to 611 12th St., Franklin, Pa.
BROWN, R. M.—from Gebhart Co. to 412 Forbes Ave., Dayton, O.
BUXTON, C. B.—from 1320 W. 10th St., Erie, Pa. to American Locomotive Co., Schenectady, N. Y.
CANNON, J. D.—from 1414 Grand Ave to 622½ Fifth Ave., Milwaukee, Wis.
CHAMBERLAIN, G. D.—from Standard Seamless Tube Co., Ambridge Pa. to Box 321, Monessen, Pa.
DAVIS, G. F.—from 2 Hubbard Court, to 206 Broad St., Charleston, W. Va.
FITZGERALD, J. J.—from 231 California Ave. to 254 Connecticut Ave., Detroit, Mich.
GUSTAFSON, R.—from 4621 Fifth Ave., Moline, Ill. to 2827 S. Michigan Ave., Chicago, Ill.
HADLEY, F. V.—from P. O. Box 1872 to 18 Tremont St. Boston, Mass.
HANCOCK, G. M.—from Olean Chemical Co. to Union Charcoal & Chemical Co., Olean, N. Y.
HANSELL, H. V.—from 50 East 42nd St. to Park Row Bldg., New York City.
HERSCH, S.—from Automobile Machine Co. to 1257 E. 134th St., Cleveland, O.
JACKMAN, A.—from 710 W. Lake St., Chicago to Dixon Hotel, Kansas City, Mo.
JOHNSON, A. S.—from 24 William St., New Britain, Conn. to 23 Grant St., Chicopee, Mass.
KELLY, R. C.—from 721 25th St. to 2402 Ninth St., Moline, Ill.
KERR, Charles A. T.—from Diamond Chain & Mfg. Co. to Lafayette Motor Co., Indianapolis, Ind.
KILDUFF, J. W.—from Gray & Davis, Amesbury, Mass. to American Bosch Machine Co., Springfield, Mass.
KIRCHER, W. F.—from 815 Hickory St. to 536 N. 24th St., East St. Louis, Ill.
KISSAN, W. H.—from 1105 Chester Ave. Cleveland, O. to Cyclops Steel Co., 120 Broadway, New York City.
LANGDON, B. F.—from 3701 Forest Park Blvd. to 5610 Eitgel Ave., St. Louis, Mo.
LEECH, John—from International Silver Co. to Holmes & Edwards Silver Co., Bridgeport, Conn.
LEOPOLD, R. P.—from 2834 to 2846 N. Marshall St., Philadelphia, Pa.
MILLER, D.—from 1422 Mulberry St., Rockford, Ill. to 318 Douglas St., San Diego, Cal.
NASH, H. L.—from 183 Benefit St. to 176 Camp St., Providence, R. I.
NORRIS, F.—from 911 Main St. to 802 East St., Three Rivers, Mich.
OLSEN, C. W.—from 41 New Park Ave. to P. O. Box 1175, Hartford, Conn.
PARDEE, H. A.—from Halcomb Steel Co., Syracuse, N. Y. to Park Wks. Crucible Steel Co. of America, Pittsburgh, Pa.
PARKS, R. C.—from 206 Broad St. Charleston, W. Va. to 352 Rhode Island St., Buffalo, N. Y.
PFEIFER, C. B.—from 1594 Pennsylvania Ave. to 3691 E. Jefferson Ave., Detroit, Mich.
PIERCE, Paul—from 2015 Bellefontaine Ave., Indianapolis, Ind. to 1110 Main St., Buffalo, N. Y.
PUSITZ, L.—from 1325 Theodore to 5348 Russel, Detroit, Mich.
PUTNAM, W. S.—from New Salem, Mass. to University of Illinois, Urbana, Ill.
RAU, Edward—from 9402 Ravenwood to 5504 Martindale Ave., Detroit, Mich.
SAULINER, Theodore, from Leeds & Northrup to N. Princeton Ave., Swarthmore, Pa.
SHIPMAN, G. F.—from 404 Thomas St., to Ingersoll Rand Co., Phillipsburg, N. J.
SMITH, S. G.—from 97 Boulevard to 123 Sisson Ave., Hartford, Conn.
SPILSBURY, H. G.—from Metal & Thermit Corp., New York City to Long Island, N. Y.
STANTON, R. F. V.—from 33 Hamilton St. to 207 Hillside Ave., Hartford, Conn.

TAYLOR, James—from 17 Harvard St., Schenectady, N. Y. to 312 Third St., Scotia, N. Y.
WADUND, A. P. R.—from 319 New York Ave. to 30 Fairview St., Hartford, Conn.
WHITE, Ray G.—from B. M. Jones & Co., New York City to Crerar, Adams & Co., 239-259 E. Erie St., Chicago, Ill.
WILLETT, J. A.—from 5308 Larchmont to 3737 Blaine, Detroit, Mich.
WILLSE, C. D.—from 2611 South 16th St. to 1886 N. Taney St., Philadelphia, Pa.

MAIL RETURNED

BUCH, James A., R. F. D. No. 7, Schenectady, N. Y.
CLELAND, Theodore G., Standard Fuel Appliance Co., 1646 Woodward Avenue, Detroit, Mich.
DONOVSKY, Z. D., 556 Norton Ave., Hammond, Ind.
EBNER, F. L., 1922 Freeman's Ave., Easton, Pa.
GILMOUR, M. L., (M-8), 406 Hennepin Ave., Dixon, Ill.
HENLEY, W. A., U. S. N. O. P., S. Charleston, W. Va.
HOLMES, W. M., Edward Valve & Mfg. Co., E. Chicago, Ind.
HURLEY, William B., 2895 West Blvd., Detroit, Mich.
JACOBSEN, O., Duriron Castings Co., Dayton, O.
MARCUSEN, Harold, (M-1), John Deere Plow Co., Moline, Ill.
MARSTERS, L. E., 7 Dowes St., Everett, Mass.
McGOVERN, P. F., Quigley Furnace Spec. Co., New York City.
SEMONS, Frank, Spring Perch Co., Stratford, Conn.
STUBING, A. F., Railway Mechanical Engineer, Woolworth Bldg., New York. City.
WARD, W. R., Lyells, Va.

News of the Chapters

LEHIGH VALLEY CHAPTER

BEGINNING with a meeting to be held Oct. 10 and continuing monthly throughout the entire season, with meetings on the second Monday of each month, the Lehigh Valley Chapter will institute a series of practical talks on "The Manufacture and Treatment of Steel." The subject has been divided in four parts, namely, manufacture of steel, forging, heat treating, and laboratory practice. Manufacture of steel will include producing of ingots, forging, rolling, casting, manufacture of tool steel, and general inspection. Forging will embody all kinds of forging such as drop forging, press and simple forging. In heat treating will be considered treating of forgings and castings, carburizing, heating and quenching, tempering, and heat treating or hardening of cutting tools. Laboratory practice will consist of chemistry, physical testing, pyrometry, and microscopic examination. The talks will be given by men from the Chapter who have made their subjects a specialty and men who are thoroughly capable of discussing the subjects in a practical manner. J. E. Halbing, Ingersoll-Rand Co., Phillipsburg, N. J., is chairman of the Chapter and A. P. Spooner, Bethlehem Steel Co., Bethlehem, Pa., is secretary-treasurer.

Commercial Items of Interest

ALL trades and industries have been asked to co-operate in the "Perfect Package Movement" to be inaugurated by the railroads, steamship lines and express companies in the United States and Canada in November, which has been designated as "Perfect Package Month." The purpose of the movement is to stimulate further public interest in good packing of shipments and to enable the carriers to improve the transportation service of the country. During November, an examination of all shipments sent by freight or express, will be conducted, to obtain information as to the best shipping methods carried on by the various trades and industries.

In every city and town, the railroad and express people will form campaign committees, to co-operate with local shippers' associations, in carrying out the plans announced for "Perfect Package Month." "Exception Reports" will be made out for all faulty shipments discovered and these reports will be sent to the shippers' association for tabulation, to ascertain how high a percentage of perfect packages, the shippers of that city have attained.

Comparisons of the records made by the various cities during November will be announced at the conclusion of the drive. The entire working forces of the railroad and express carriers, comprising some 2,000,000 men, will aid in the movement. The railroads, through the American Railway Association, composed of practically all of the rail-

roads in the country, are pushing the campaign, as a means of raising the standard of the service, while the express agents are also preparing to interest shippers in the undertaking.

In an effort to improve and stimulate present day business, the Simonds Mfg. Co., Fitchburg, Mass., has sent out to its customers an interesting letter containing some good suggestions. Portions of the letter are worthy of attention and are as follows:

"For the last 12 months we have been liquidating. We have all been wearing out our old shoes, our old clothes, patching up our tools, reducing our stocks and getting along without purchasing, excepting only just the various essentials absolutely necessary to carry along our much depleted business. We have cut out extravagance in so far as purchasing materials is concerned, but statistics prove that we have added another far greater piece of extravagance to our list than any heretofore indulged in, and that is the extravagance of wasted time. We have reduced our energies more in proportion than we have reduced our expenses, and most of us find ourselves today wastefully waiting and watching for the gold nuggets to come to us. In other words, we have stopped hustling.

"We can get along on very little if we force ourselves to do so, but what do we gain by it? The world needs products and all kinds of products. The best thing for all of us to do is to take our losses and start in to work and build them up again; mark the prices of our goods down and cut the price of labor down, and insist on more hours work from every employe and more active work from all salaried employes. Start booming activity and by the reduction of prices enable those working for a lower wage to procure as much, or nearly as much, as during the war period. We all need to stimulate activity in business. This slothful waiting is going to hurt us all."

The Surface Combustion Co., 366 Gerard avenue, Bronx, New York, announces that early in July British Furnaces, Ltd., Millbank House, 2 Wood street, London, S. W. 1, was organized with an authorized capital of £25,000 for the purpose of manufacturing and selling Surface Combustion Co. apparatus in the British Empire. The principal stockholders are the Bryan-Donkin Co., Ltd., Chesterfield, Eng., machinists and foundries; Duckham & Jones, Ltd., London, engineers and manufacturers, and the Surface Combustion Co., New York. The latter company is now represented in all principal European countries and several large industrial furnace installations already have been made. The Compagnie Generale de Construction de Fours, 32 et 34 Rue de la Grange-aux-Belles, Paris, are the sole licensees and manufacturers for the company's apparatus in France and its colonies, Belgium, Holland, Switzerland, Italy, Spain and Portugal. John H. Bartlett Jr., foreign representative for the Surface Combustion Co., has had charge of this work during the last few years and personally supervised the organizing of the foreign sales and manufacturing departments of the new companies.

According to a recent announcement of the United States Civil Service Commission, an open competitive examination will be conducted for a metallurgical chemical laboratorian on Nov. 2. The duties of the appointee will include physical tests, heat treatment, and metallographic

examination of metals; determination of transformation temperatures; calibration of instruments, such as pyrometers; calculation and plotting of results of tests; making sketches and drawings of apparatus. Details of the examination as well as the places of examination may be secured from the United States Civil Service Commission, Washington.

A late bulletin of the E. J. Codd Co., Baltimore, describes new chain furnace and oven doors which are finding wide application on metallurgical, glass and chemical furnaces. These screens consist of a multitude of individual strands of steel chain, forming a penetrable transparent sheet which does not interfere with the view of the interior of the furnace, the passage of the charge, nor the tools necessary for manipulation of the same, yet keeps the heat in and the cold out of the furnace. Several illustrations describe the pamphlet.

TRANSACTIONS is in receipt of the *Bulletin* of the American Foundrymen's Association, which made its initial appearance with the September issue. Its purpose is to keep members informed on association activities, report committee progress, and furnish abstracts of current foundry literature. It will fill the need for a means of communication between the association and its members in the intervals between conventions. The *Bulletin,* which consists of eight pages, is published at 140 South Dearborn street, Chicago. Welcome and best wishes to the new publication.

Tate-Jones & Co., Inc., Pittsburgh, has distributed to readers of *Metal Heating,* a journal published by that company, reprints of a paper "Furnace Conditions for Proper Treatment of Die Blocks," by Dr. S. Trood of the same company. The paper which was presented at the convention of the American Drop Forge Association, June 24, is reprinted from a recent issue of *Forging and Heat Treating.* The furnace discussed is an automatically controlled oil-fired furnace for annealing and hardening die blocks, this type replacing an electric furnace which was more expensive in first and in operating cost.

The Kinite Co., Milwaukee, is circulating a 24-page illustrated booklet in which an alloy for shear blades, re-drawing tools, blanking dies, draw dies, embossing and forming dies, broaches, etc., is described and illustrated. This alloy, according to the booklet, has great resistance to wear, dense structure and close grain, air-hardening quality, freedom from distortion when hardening, and ability to take high polish. In the booklet many examples in the large increases in number of pieces per dressing of tool are given.

At a recent meeting of representative Michigan manufacturers with the directors of the engineering research department of the University of Michigan, Ann Arbor, Mich., approximately $25,000 was pledged for use in advertising that department. About 50 manufacturers attended the meeting. Since the department was organized nearly a year ago, the laboratories, under the direction of Prof. A. E. White, have been co-operating with the industries of the state in the study of problems which would result in public benefit.

Considerable work has been accomplished already but at the recent meeting it was felt that through lack of advertising funds the results were not being utilized to best advantage.

Announcement is made of the incorporation of the Pennsylvania Pressed Steel Corp. with an authorized capitalization of $1,000,000. The officers are: C. K. Olberg, president; Dr. Walter M. Mitchell, vice president; Thomas Gamon Jr., secretary; and L. P. Warner, treasurer. The company will engage in the manufacture of pressed and stamped sheet steel and metal products, automotive equipment, etc. Its plant is located at Wayne Junction, Philadelphia.

Contract for a 90-kilowatt, 220-volt, 3-phase, 60-cycle continuous electric furnace for heat treating ring gears recently was awarded the George J. Hagan Co., Pittsburgh, by the Dodge Bros. Co., Detroit.

Construction of a new drop forging plant 70 x 300 feet, has been authorized by the Columbus Forge & Iron Co., West First avenue, when contracts for the building were given to the Middle States Construction Co. The building, which will cost approximately $50,000, is needed to care for the increase of the company's business, according to Manager David Singleton. It is also planned to remodel the present buildings, while much new machinery will be installed. The company makes anvils in addition to drop forgings of all kinds.

The Indianapolis Metal Treating Co. has established a plant at South and Meridian streets. The company was organized by Edward Turnquist and Frank Mattson, both of Anderson, Ind. Modern equipment has been installed and more machinery has been ordered. Mr. Turnquist is the president of the company and Mr. Mattson plant manager. These men have had many years' experience in the treatment of high speed and common steels.

F. J. Ryan & Co., Philadelphia, industrial furnace builders, have moved their general and sales offices from the Franklin Trust building, Philadelphia, to the Wesley building, Seventeenth street and the Parkway, Philadelphia.

Bulletin No. 234, "The Continuous Treatment of Metals with Automatic and Semiautomatic Furnaces," is the fourth of a series dealing with fundamentals that influence the quality and cost of heated products. This bulletin illustrates practical application of the principles outlined by the previous bulletins of this series. Bulletin No. 230, "The Production of Heat Treated Products" contained five papers: (1) "Factors Governing Quality and Cost of Heat Treated Products;" (2) "Relation of Temperature Control to Uniformly Heated Product;" (3) Selection of Furnaces;" (4) "Relation of Price of Fuel to Cost of Production;" and (5) "Influence of Furnace Design on Quality and Cost of Product." Bulletin No. 231, "Selection of Fuels," contained five papers: (1) "Factors Governing the Selection of Fuels;" (2) "Comparative Fuel Prices on B.t.u. Basis;" (3) "Comparative Heating Value of Industrial Fuel Gases;" (4) "Composition of Industrial Fuel Gases;" and (5) "Utilization of Fuel Resources." Bulletin No. 232, "The Variety of

(*Continued on Page* 33)

(*Continued from page* 80)

Furnace Design," contained three papers: (1) "The Variety of Industrial Heating Requirements;" (2) "Regenerative Furnaces;" and (3) "Relation of Type and Arrangement of Furnaces to Cost of Production."

A stereoscopic eyepiece, recently developed, to be attached to almost any monocular microscope, eliminates eye fatigue since it is not necessary to keep one eye closed or to suppress one image when both eyes are open. This eyepiece, which is manufactured by the Bausch & Lomb Optical Co., Rochester, N. Y., is designed with the eyepiece tubes parallel. This permits the eyes to be used in the natural way, with relaxation from convergence just as if they were directed at a far distant object. The draw tube of the device is made interchangeable with most monocular eyepieces.

"The Working of Steel" is the title of a new book written by Fred H. Colvin and K. A. Juthe, and recently published by the McGraw-Hill Book Co., Inc., New York. The volume contains 245 pages, 6 x 9 inches and is bound in cloth. By way of review *The Iron Trade Review* says:

"To supply information as to the most approved methods of working the various kinds of steel now in commercial use, is the purpose of this book. Increasing uses of steel in all industries and the necessity for securing the best results with the material used, make a knowledge of the proper working of steel more important than ever before. The authors state that it is not alone the quality of the steel itself or the alloys used in its composition, but the proper working or treatment of the steel which determines whether or not the best possible use has been made of it.

"The text includes the discussion of low carbon, high carbon and alloy steels of various kinds, and from a variety of industries. The automotive industry which has done much to develop not only new alloys but efficient methods of working them, was drawn on for information. Practice in government arsenals on steels used in firearms is also given. While it was not intended to make the book a treatise on steelmaking or metallurgy, a little information is included regarding the making of various steels, also considerable general information which will be found helpful to those desiring to become familiar with the most modern methods of working steel.

"To make the volume more complete, a number of tables, and illustrations are used. Twelve chapters are included together with an appendix of important tables. Chapter headings are as follows: I. Steelamking; II. Composition and Properties of Steels; III. Alloys and Their Effect Upon Steel; iV. Application of Liberty Engine Materials to the Automotive Industry; V. Forging of Steel; VI. Annealing; VII. Case Hardening and Surface Carburizing; VIII. Heat Treatment of Steel; IX. Hardened Carbon Steel for Tools; X. High Speed Steel; XI. Furnaces; and XII. Pyrometry and Pyrometers."

The Vanadium-Alloys Steel Co., Latrobe, Pa., is distributing to the trade a handy reference card giving a number of practical pointers to the tool hardener. This card, which is 8½ x 11 inches and made of heavy cardboard, is provided with cord for hanging on the wall or bench. On one side are printed 37 tips and on the other side are shown the various grades

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EMPLOYMENT SERVICE BUREAU

The employment service bureau is for all members of the Society. If you wish a position, your want ad will be printed at a charge of 50c each insertion in two issues of the Transactions.

This service is also for employers, whether you are members of the Society or not. If you will notify this department of the position you have open, your ad will be published at 50c per insertion in two issues of the Transactions. Fee must accompany copy.

Important Notice.

In addressing answers to advertisements on these pages, a stamped envelop containing your letter should be sent to AMERICAN SOCIETY FOR STEEL TREATING, 4600 Prospect Ave., Cleveland, O. It will be forwarded to the proper destination. It is necessary that letters should contain stamps for forwarding.

POSITIONS WANTED

MECHANICAL ENGINEER—Age 33, married, 18 years experience as designer, machine shop foreman, chief draftsman, and efficiency engineer. Broad experience in designing of gas furnaces, special machinery, tools, jigs, fixtures, gauges and dies. Well acquainted with steel treating and hardening. Desires position where initiative and inventive ability along manufacturing lines are considered. Address 8-1.

SUPERINTENDENT OF TIME—In automobile plant. One year Govt. inspector on forge work, one year testing drop forgings and inspecting same, three years laying out forging machinery and taking time studies, also have taken time studies in assembling automobiles. Salary $300.00 per month. Address 8-2.

SALESMAN—Have had 6 years in chemical and physical laboratories of tool steel concerns. 3 years in charge of heat treating tool steels. No preference as to location. Wages $175.00 a month. Address 4-4.

SUPERINTENDENT OR FOREMAN—In heat treating department; 21 years experience in heat treating. Employed at present with large heat treating plant. Desire to make change. Salary desired $3000. Address 10-2.

GENERAL SUPERINTENDENT OR PRODUCTION MANAGER—8 years as general superintendent with large manufacturing firm. Expert on manufacturing fire arms and munitions, machinery and small interchangeable parts. Eastern location preferred. Address 4-1.

CHEMIST OR METALLURGIST—6 years as chemist and three years as chief chemist and assistant to the metallurgist. Cleveland location preferred Address 4-2.

SALESMAN—Selling steel or metallurgical supplies. Knowledge of Spanish, Willing to travel. Have been chief metallurgist for large Eastern firm. 7 years experience in heat treating of carbon, alloy and high speed tool steel, and general production work. Experienced in metallography, physical testing, pyrometry, and analysis. Best of references. Address 4-3.

METALLURGICAL ENGINEER—Columbia University graduate. 7 years experience in steel treating plant, also research department of large steel manufacturing company. Experience included laying out and overseeing commercial heat treatments of small automobile parts, and similar products, and testing of same; design and installation of heat treating equipment; installation and maintenance of pyrometers; research work on high tensile and shock resisting structural steels, too lsteels, magnet steels, etc.; micro examinations and microphotography; magnetic measurements; critical temperature measurements. Salary $200—$250 per month, depending on location. Address 10—3.

POSITION WANTED—In metallurgical laboratory of heat treating room. 17 years practical experience in heat treating, specializing in tool hardening. No restrictions as to location. Reasonable salary. Address 8-3.

FOREMAN OR ASSISTANT FOREMAN—Practical, experienced in all around forging, blacksmithing and treating of steel. Experienced with tools used in shipyards and machine shops. Prefer location in Chester, Pa., Camden, N. J., or Philadelphia, Pa. Address 4-5.

METALLURGIST OR ASSISTANT METALLURGIST—College graduate. At present assistant metallurgist in large motor car company. Capable of handling heat treating, microscopic work, chemical analysis, and pyrometry. Desire Central or Western location. Salary $250.00 per month. Address 4-6.

METALLURGICAL ENGINEER—Young, capable, energetic, with 11 years experience. Graduate engineer. Bureau of Standards for 7½ years. Erie Forge Co. for 3 years. Expert in pyrometry in steel plant, forge shop, open hearth and heat treating plants, metallurgy, investigations and research, planning metallurgical operations, heat treating carbon or alloy steels, and management, forge shop temperature scheduling, etc. Salary desired $3000, or make your proposition. Answer 7-2.

METALLURGIST—Age 25, experienced in manufacture of steel from blast furnace to the finished, heat treated and tested product. Desire to form a connection with company now building up an organization where opportunity at present as the future shall predominate. Cleveland district preferred. Answer 7-1

SUPERINTENDENT OF HEAT TREATING—Have had 12 years' experience as blacksmith and in heat treating. At present in charge of same in large automobile plant. Have installed equipment, and have some experience along mechanical lines. During war in charge of aircraft forging, heat treating and as metallurgist. Salary desired $3600. Answer 7-1.

HEAT TREATING FOREMAN—Two years pyrometrical and heat treatment of gun forgings; one year heat treatment and physical testing of rolled bar stock, and simple analysis; 1½ years heat treatment, carburizing, and hardening of automobile forgings. Address 9-5.

FOREMAN: 30 years practical experience in heat treating, forging tool hardening, carbonizing. 5 years as foreman of heat treating. Location preferred in Pennsylvania, New Jersey, or Maryland. Salary desired $200 per month. Address 9-3.

METALLURGIST—CHEMIST—Former member chemical engineering staff of University of Michigan; chief metallurgist Packard Motor Car Co.; metallurgist drop forge company. Address 9-1.

(*Concluded from page* 33)

of tool steel made by the company. The advice given is worthy of attention and is reproduced in full as follows:

TIPS FOR THE TOOL HARDENER

Suggestions of a Practical Man of Long Experience

There are fixed laws in Metallurgy as well as in nature—STUDY THEM—OBEY THEM.

A piece of steel can only absorb a certain amount of heat in a given time. Because you are in a hurry you cannot force heat into the steel—TAKE TIME.

A thin section of a tool heats quicker and cools quicker than a larger section; REMEMBER this when you quench a complicated piece.

There is a LAW of CAUSE and EFFECT—STUDY IT.

When a tool cracks or warps in hardening, you have the EFFECT of your error. STOP THERE. Find out the CAUSE.

Keep your quenching tanks clean and your quenching medium at a uniform temperature.

SCALE is oxide of iron which you make yourself. It does not contain carbon and will not harden. DON'T MAKE IT. Use a REDUCING atmosphere in your furnace, by using an EXCESS of FUEL—NOT AIR.

There is a fixed law of EXPANSION and CONTRACTION. YOU CANNOT CHANGE IT.

Keep your furnace IN REPAIR. Avoid leaky bottoms.

A pyrometer is not a cure-all. It is only there to GUIDE you.

Pyrometers are like all mechanical devices—they need ATTENTION and REPAIR.

It is no disgrace to spoil a tool in hardening, but it is a DISGRACE to spoil a tool AND NOT FIND OUT WHY you spoiled it.

KNOW THE STEEL YOU ARE HARDENING so as to give it correct temperature and quenching medium.

If you do not know the composition of the steel, first try a piece off the bar. Do not experiment on a costly tool. Hardening an unknown steel is like taking a leap in the dark.

Correct hardening is the GREATEST FACTOR in obtaining maximum production from tools.

Your work makes or breaks production.

Heat your work slowly and avoid distortion. Steel does not contract at the same rate that it expands.

Keep records of your work to PROTECT yourself, and to AID you in the future.

Don't keep your records in your HEAD. Keep them in a BOOK.

Look out for SHARP CORNERS. Insist on having them filleted when possible.

Harden only the working part of a tool when possible—leave the other part soft.

Tools crack at the point of LEAST RESISTANCE. WATCH THAT POINT.

Find out what WORK a tool has to do. HARDEN AND DRAW the tool to suit the WORK it has to PERFORM.

The HARDNESS of a tool may suit YOU, but will it suit the JOB it has to perform? FIND OUT.

Do not confuse BRITTLENESS with HARDNESS. A tool should be HARD, yet TOUGH.

It should never be BRITTLE.

Steel is not an inert substance. It is ALIVE. Treat it as such.

Steel is scientifically made—HARDEN it scientifically.

HARDENING is a SCIENCE—not a SECRET.

ASK questions—ANSWER questions. You cannot expect to receive information if YOU do not GIVE any.

Keep your hardening room CLEAN and NEATLY arranged.

THINK before you harden.

Prove your worth to your employers.

Don't be a LUCKY hardener—be a SCIENTIFIC hardener.

REMEMBER: HIGH carbon—a LOW hardening heat; LOW carbon—a HIGH hardening heat.

Study your problems BEFORE hardening—not AFTER the tool is ruined.

Don't let your work stand around after hardening—DRAW IT AT ONCE.

TIME and TEMPERATURE are important factors, but DON'T FORGET the HUMAN element—YOURSELF.

Statement of the ownership, management, circulation, etc., required by the act of congress of Aug. 24, 1912, of TRANSACTIONS of the American Society for Steel Treating published monthly at Cleveland, O., for October 1, 1921. State of Ohio, county of Cuyahoga, ss. Before me, a notary public, in and for the state and county aforesaid, personally appeared W. H. Eisenman, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the TRANSACTIONS of the American Society for Steel Treating, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of Aug. 24, 1912, embodied in section 443, Postal laws and regulations, to wit: 1.—That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, American Society for Steel Treating, 4600 Prospect avenue, Cleveland, O.; Editor, E. F. Ross, 4600 Prospect avenue, Cleveland, O.; Business Manager, W. H. Eisenman, 4600 Prospect avenue, Cleveland, O. 2.—That the owners are: The American Society for Steel Treating, 4600 Prospect avenue, Cleveland, O., which is an educational institution, the officers of which are: President, F. P. Gilligan, Hartford, Conn.; First Vice President, F. C. Lau, Chicago, Ill.; Second Vice President, R. J. Allen, Springfield, Mass.; Secretary, W. H. Eisenman, Cleveland, O.; Treasurer, J, V. Emmons, Cleveland, O. 3.—That known bond holders, mortgagees and other security holders are: none. 4.—That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. W. H. Eisenman, Sworn to and subscribed before me this 8th day of October, 1921. (Seal.) H. W. Hart. (My commission expires July 6, 1922.)

This qualification record will be printed in the "Men available" section of the Employment Bureau of the Transactions at a cost of 50c each insertion.

The money to cover this Charge should accompany this form.

QUALIFICATION RECORD—Strictly Confidential

Name

Address

No. of Years in Grammar School? | **Other Schools?**

Experience:

Wages Desired? | **Location Preferred** | **Kind of Position Desired**